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How Big is Your Field?

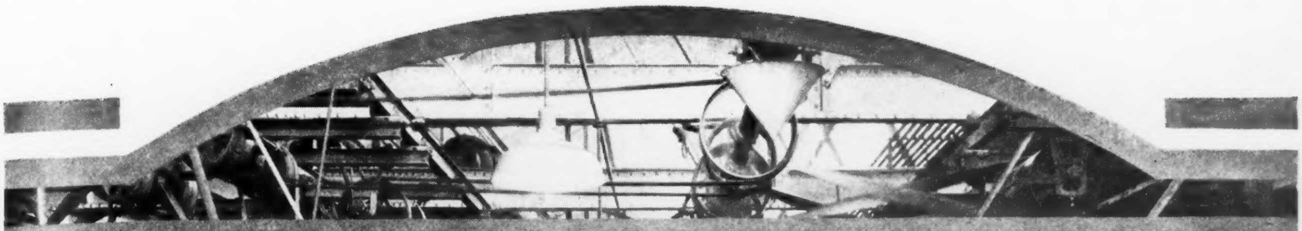
That the automotive industry is the giant of all and the largest buyer of machine tools and accessories does not mean that the component plants did not begin small; nor that some of the advantages of their improved manufacturing methods, including mass production and highly efficient production machinery, cannot be adapted in some cases to smaller—even to small—plants.

The success of the automotive industry was achieved not alone because its field was universal; but also because the executives of successful plants spent money almost without limit, but judiciously, to produce their product at prices that created a universal demand.

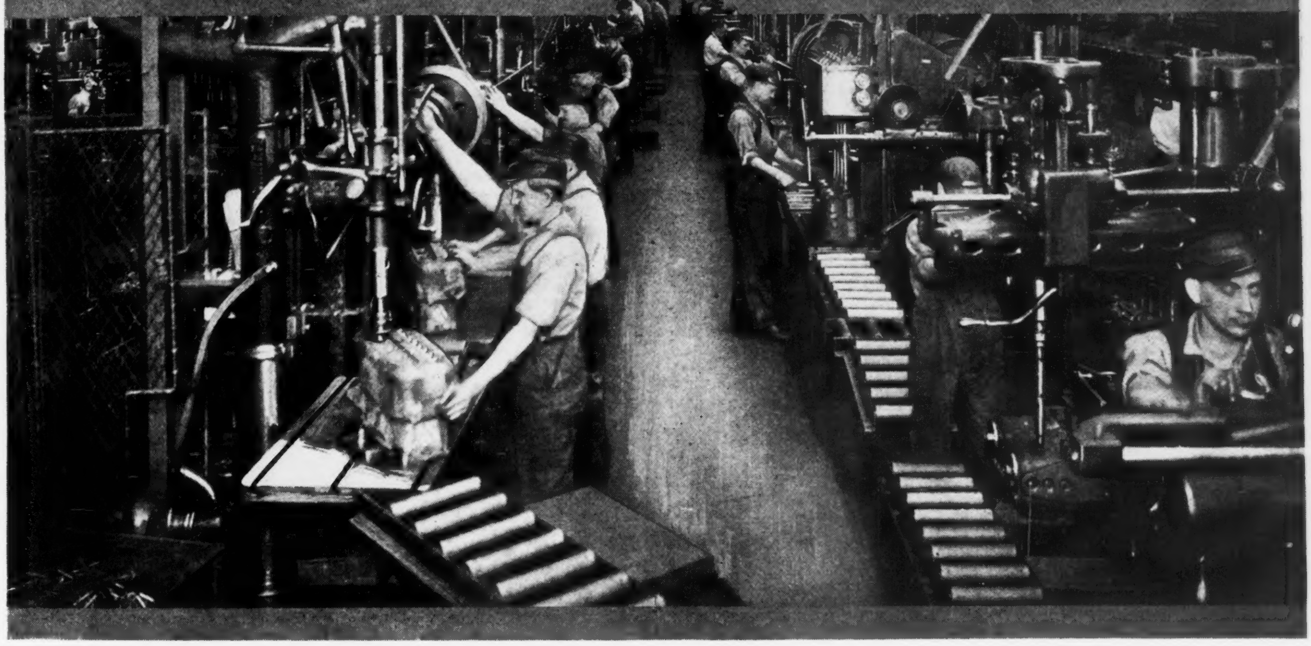
Whether your field is large or small you can profit by studying their methods; for many of the principles underlying tools and methods are the same.

In the reading and advertising pages of October MACHINERY you are sure to find the basis for some idea that can be applied or adapted with profit in your own plant.

Prosperity is ahead; prepare to get your share.



Increasing Production with New Equipment



Results Obtained by the White Motor Co. through the Installation of the Latest Types of Machines and Tooling

By CHARLES O. HERB

WHEN we compare prices of ten years ago with those of today, we find in almost every case that they have advanced materially—or, if you wish, that the dollar has depreciated in value. One important industry stands out in contrast to the general trend. The dollar that buys automobiles or motor trucks has not depreciated in value. On the contrary, not only are automobiles and trucks cheaper today than ever before, but the quality has been decidedly improved; in other words, you can buy "more car or truck" for less money.

How the Automotive Industry Achieved these Remarkable Results

What has made this condition possible in the face of increased prices in practically every other direction? A complete answer to this question would require a detailed review of the entire development in the design and production of automobiles and trucks during the last ten years. Briefly, however, the answer is that simplified design of the product, improved manufacturing methods, efficient high-production machinery, and an output sufficiently large to take full advantage of the methods developed are the factors chiefly responsible for the unique position of the motor vehicle in the price chart of the past decade.

In this industry, also, most manufacturers know the actual cost of all parts produced. Hence, the advantage of a new machine or method can be determined accurately by comparing present costs with the savings made possible by new equipment. It is no wonder, then, that this industry has always been ready to adopt new or improved machines and methods that increase production. In one model of the White motor truck there are more than 1100 distinct parts in the chassis alone. Hence, if only a slight saving could be made in the manufacture of, say, one-half of these parts, the total saving on the truck would reach an impressive figure. As one man in a well-known automobile plant put it, "It is a dime here and a nickel there that reduces the price of a car hundreds of dollars."

Thus, it has been the minute study of the methods of making each separate part, together with the introduction of more efficient methods for producing hundreds of different parts, that has enabled the industry to achieve its enviable position. In this work of reducing costs and at the same time improving quality, the automobile production managers, equipment engineers, and time-study supervisors have worked hand in hand with the machine tool builders, and it is through the cooperation of these two industrial factors that the remarkable results have been made possible. Each has drawn upon the experience of the other, and their combined efforts may be said to have produced results that not even the boldest dreamer, either in the automobile or the machine-tool building field, would have dared to predict fifteen years ago.

The Adoption of New Methods Continues

This search for still more efficient methods of producing parts continues, and readers of MACHINERY will be interested

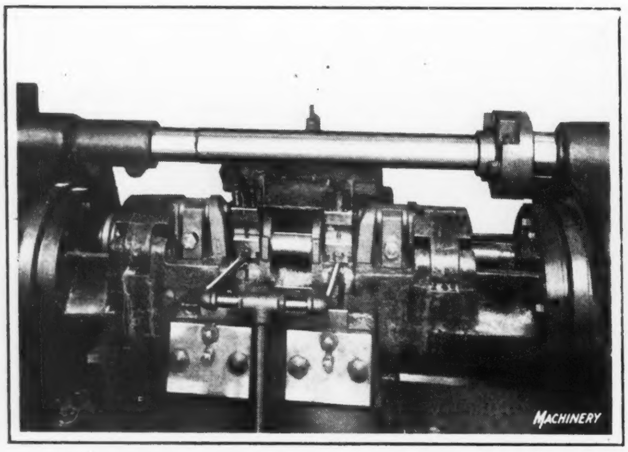


Fig. 1. Turning Two Pins on the Crankshaft at One Time

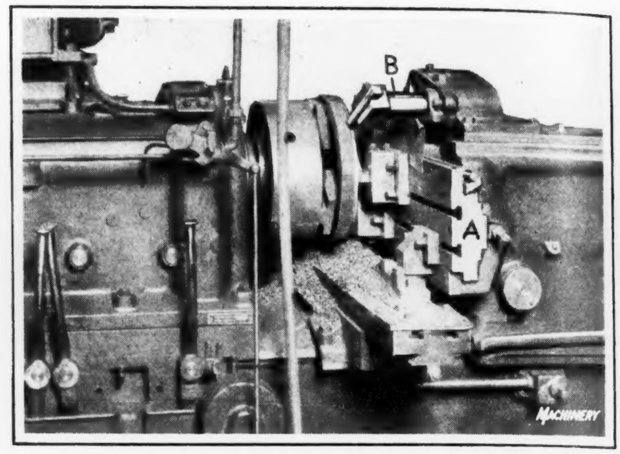


Fig. 2. First Operation performed on the Clutch Case

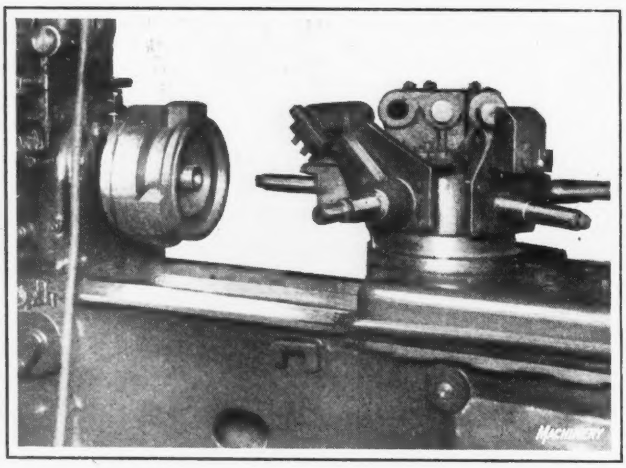


Fig. 3. Tooling for finishing Internal Surfaces of Clutch Case

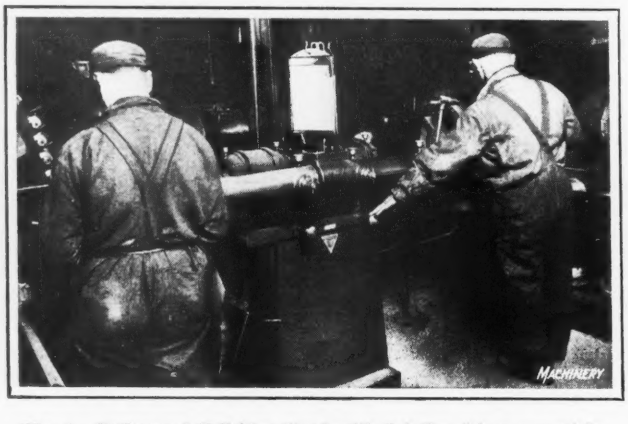


Fig. 4. Buffing and Polishing Stand with Spindles driven separately

in the remarkable results that have been obtained with improved equipment and methods by the White Motor Co., Cleveland, Ohio. In the last two years, this company has spent several million dollars for new machines and equipment. The extensive additions of the latest types of production machine tools, such as grinders, thread millers, semi-automatic and automatic machines of various types, gear cutters, gear grinders, gear burnishers, hydraulic broaches and lapping machines, have enabled the company to improve processes generally and to raise the standard of quality. Coupled with extensive plant additions and rearrangement of departments, the installation of new machinery, and the accompanying tools, fixtures, and gages, have had the desired effect of reducing manufacturing costs. Plant efficiency has been increased, and the improvements also have resulted in greater earnings for the White factory workers.

In the following will be described many of these improved methods. In each example, the percentage of increased production obtained by the new method is derived from a comparison of the old and new time-study cards, and is not merely a guess. All calculations are based on an eight-hour day.

Examples of Increased Efficiency

Turning Crankshaft Bearings and Pins—LeBlond crankshaft lathes are employed for rough-turning all pins and for turning and facing the center bearing of the crankshaft. The first operation consists of rough-turning pins Nos. 2 and 3, and the time average is 7.84 minutes per crankshaft. This operation is illustrated in Fig. 1. In the second operation pins Nos. 1 and 4 are rough-turned at an average time of 7.22 minutes. One man operates the two machines, with the result that the production per man is now about 220 per cent more than the production obtained with the old method. In the operation of turning and facing the center bearing, the time per piece averages 8.42 minutes. The production increase in this case is about 340 per cent, one less machine is

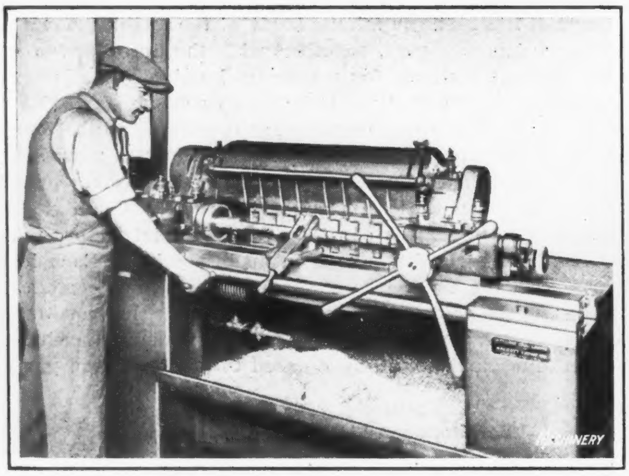


Fig. 5. Turning Eight Lobes on the Camshaft simultaneously

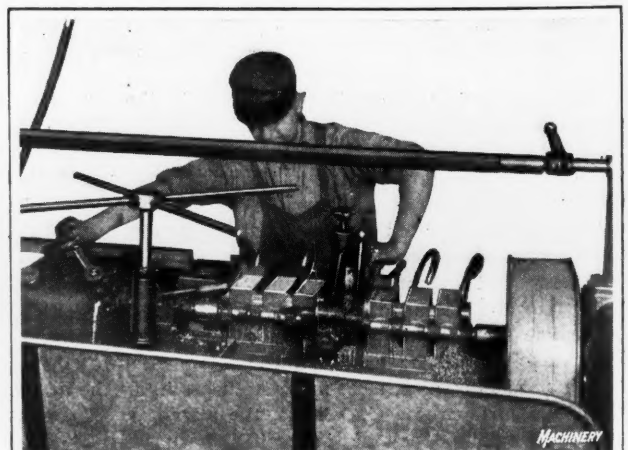


Fig. 6. Another Type of Machine used in turning the Camshaft

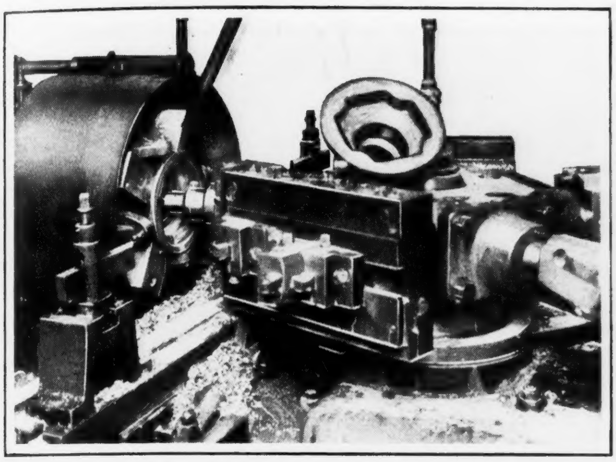


Fig. 7. Automatic equipped for machining the Differential Case

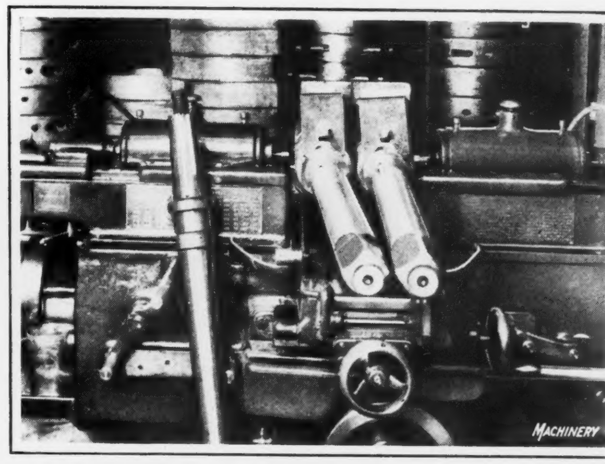


Fig. 8. Milling the Keyway in the Hub End of Two Axle Shafts

required, and the operator devotes one-half of his time to tending another machine.

Operations on Clutch Cases—The clutch case is rough- and and finish-machined all over in four operations performed in Potter & Johnston automatics. All four machines are tended by one operator, and the production averages one case every 6.37 minutes, the total machining time per case being 25.47 minutes. This production represents an increase of 1257 per cent over the previous method. In addition, about 1000 square feet of floor space is available for other machines. In the first operation, which is illustrated in Fig. 2, the periphery is rough-turned and the closed side is rough-faced. The closed side has a tapered or conical portion near the center. This conical portion is rough-machined by means of tools mounted on slide *A*, which is fed sidewise toward the front of the machine as the main slide advances toward the work. The tool that turns the periphery is held in the bar *B* contained in a bracket on the main slide.

The second operation consists of taking boring and facing cuts on the inside of the case. In this step, the internal taper surface is machined by an arrangement somewhat similar to that just described. The tools shown on the turret in Fig. 3 are employed in the third operation for finishing the various inside surfaces, the taper being finished by means of a forming tool ground to the proper angle. In the first step of this operation, the hole in the center of the clutch case is bored, and in all subsequent steps, pilots enter this hole to steady the tools. The hole is also reamed in this operation.

Buffing and Polishing Operations—Three duplex buffing and polishing stands, each of which has an individual motor drive to both spindles, have been installed for operations on various parts. One of these units is illustrated in Fig. 4. The individual control of the spindles permits changing the wheel on one spindle while the other is in operation. Previously, the belt had to be thrown off when a wheel was changed.

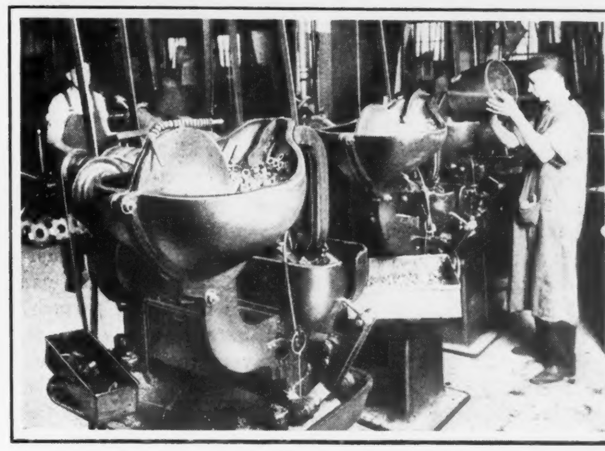


Fig. 9. Three Automatic Machines used for tapping Nuts

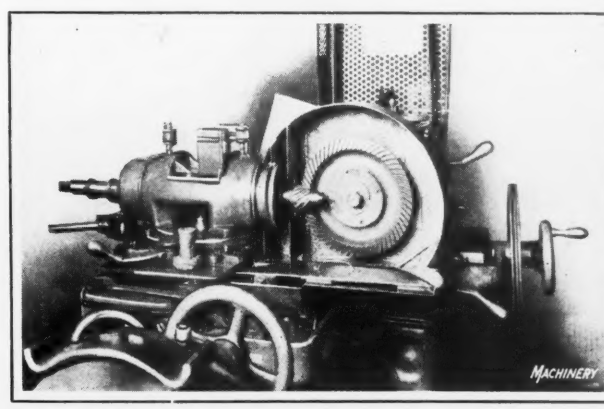


Fig. 10. Burnishing the Teeth of Spiral Bevel Pinions

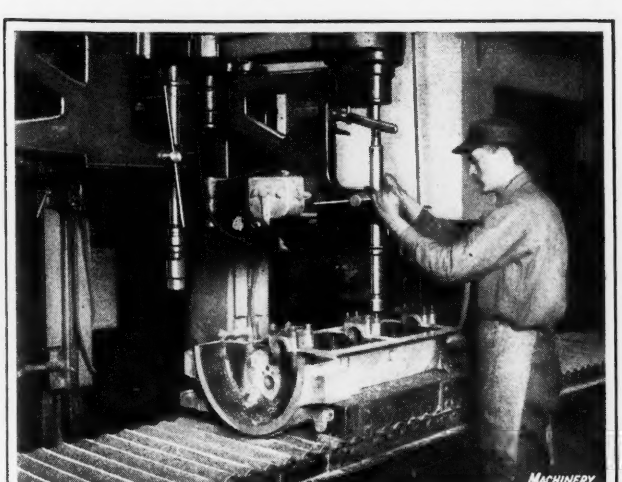


Fig. 11. Setting Studs and driving Nuts with Hinged-arm Machines

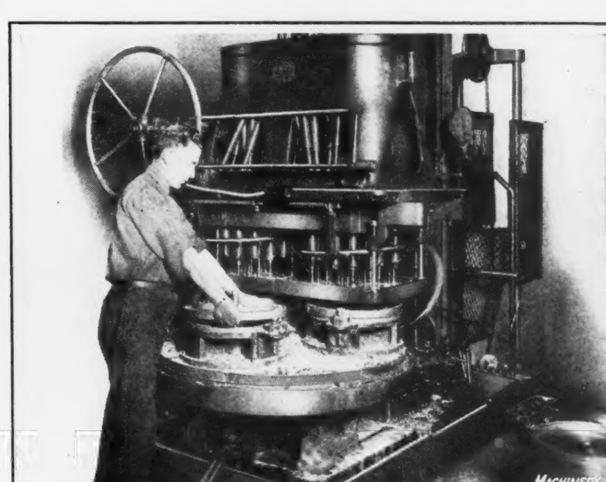


Fig. 12. Drilling Holes in the Flywheel on a Multiple-spindle Machine

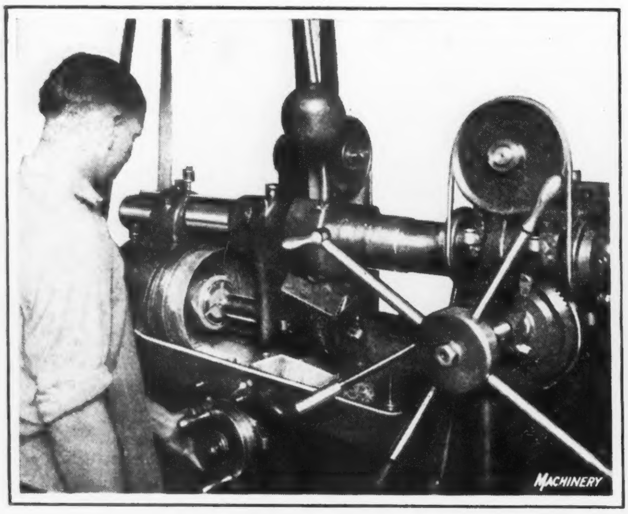


Fig. 13. Machine employed for grinding Hole in Valve Lifter Rolls

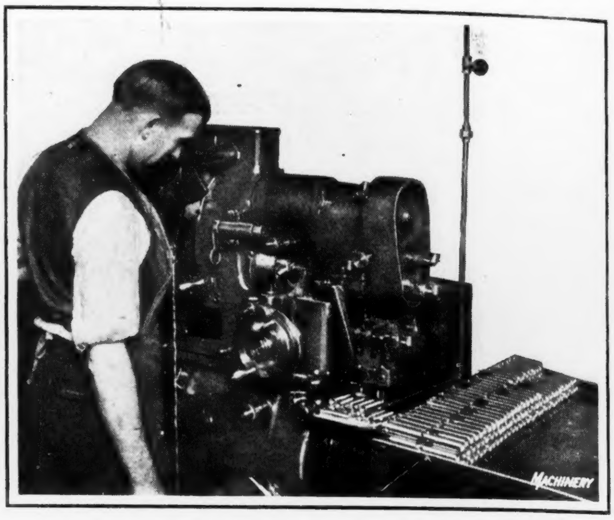


Fig. 14. Grinding the Cross Hole in the End of a Valve Lifter

Turning Camshafts—The Melling cam-turning lathe illustrated in Fig. 5 is used for simultaneously turning the eight lobes of the camshaft. Chucks of the collet type hold and drive both ends of the camshaft in this operation. Each tool moves forward and backward while turning the cam portion of the respective lobe, and dwells while turning the concentric portion. While turning the cam portion, the tool is also rocked, so that the cutting edge is always in the same relation to the surface being cut. One important feature of the machine is that an accurate camshaft is used as a master. The production in this operation, averages one piece every 4.57 minutes, which represents an increase over the old method of 254 per cent.

Three more operations on the camshaft are performed in "Lo-swing" lathes, one of which is illustrated in Fig. 6. In the first of these operations, the bearings and the flange end are turned; in the second, various surfaces are necked, and the cam lobes faced; and in the third, the portions between the lobes are turned. The machines for the first two operations are tended by one operator, while the third machine is operated by a second man. The three machines produce a camshaft every 3.69 minutes, the increase in production over the former method being approximately 400 per cent.

Finishing Differential Cases—The differential case is turned, bored, and faced complete in three Potter & Johnston automatics, one of which is shown in Fig. 7. Two of the machines take internal cuts, and the third, external cuts. One man operates three machines, and turns out a finished case every 12.63 minutes. The increase in production over the method previously employed is 260 per cent.

Milling the Keyway in Axle Shafts—The keyway in the hub end of the axle shaft is produced in the Taylor & Fenn spline milling machine illustrated in Fig. 8. This machine is equipped with a fixture that receives two shafts at one time. The cutter-heads may be made to advance either in unison or alternately, and the feed of the heads continues

Fig. 15. Multiple-spindle Drilling Machine equipped for drilling and reaming Bolt Holes in the Clutch Cover

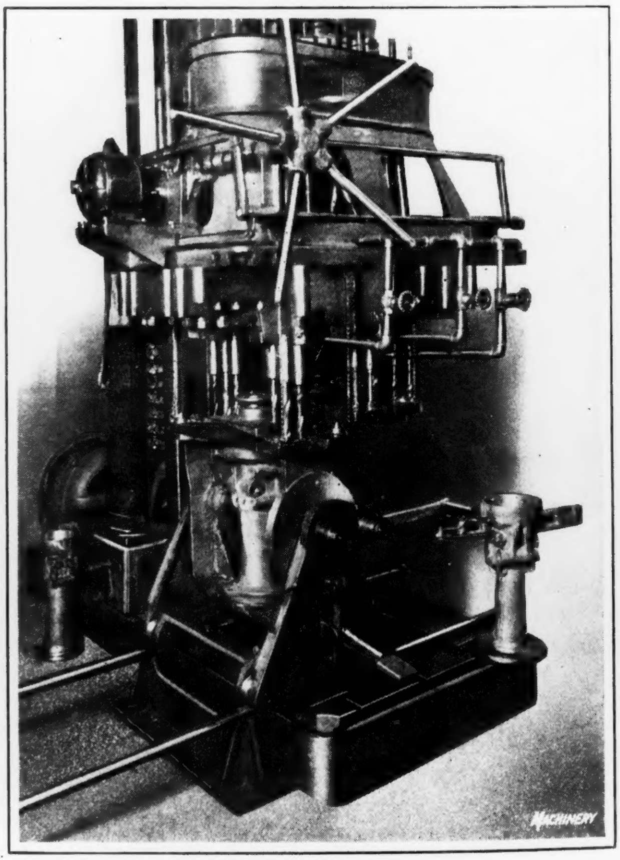


Fig. 16. Multiple-spindle Drilling Machine and Fixture employed for drilling the Arms and Flange of the Axle Housing

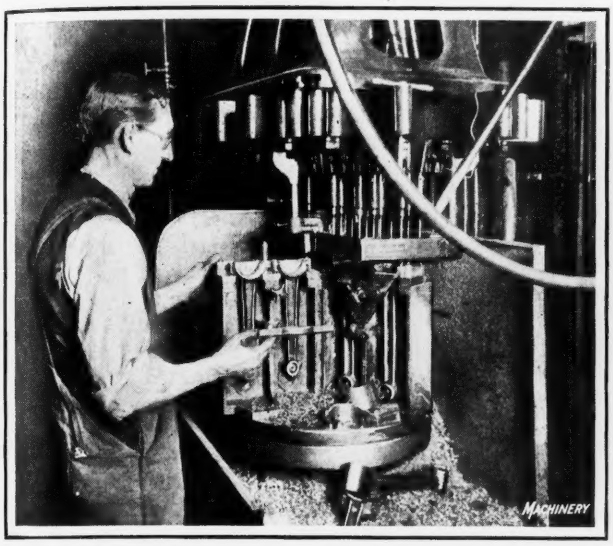


Fig. 17. Machine Set-up employed in drilling and reaming Bolt Holes in Connecting-rods and Caps

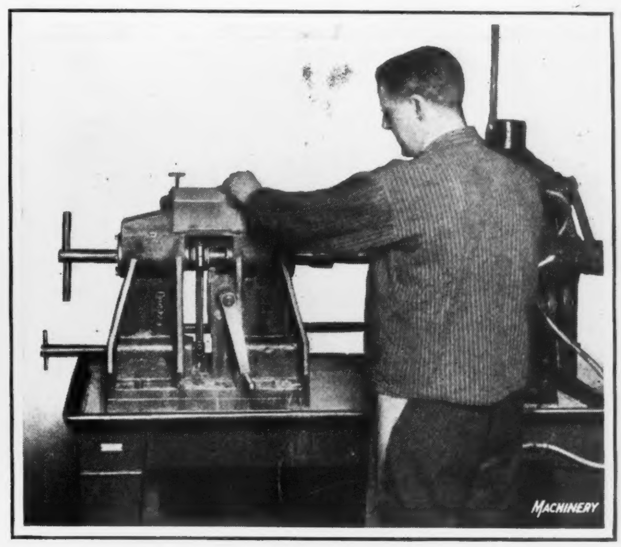


Fig. 18. Special Machine employed for diamond-boring the Crank End of Connecting-reds

until a predetermined depth of cut is reached. There is an adjustment for the length of the table movements. One man runs two machines, the production per machine averaging one shaft every 7.39 minutes. The increase in production is 233 per cent, and one machine and one man have been eliminated.

Tapping Nuts—Nuts from 3/8 to 5/8 inch are tapped automatically in the National machines illustrated in Fig. 9. These machines are entirely automatic, and use bent taps. From the hopper of each machine, the blank nuts pass down a feed-chute to a reciprocating member which feeds the blanks one at a time on the tap. The nuts pass up the shank of the tap, from which they are finally ejected and fall from the machine. The average nut is produced in 0.104 minute, which represents an increase in production of 91 per cent over the method previously used.

Burnishing Spiral Bevel Pinions—For burnishing spiral bevel pinions, the special machine illustrated in Fig. 10 was developed. In this machine, the burnishing consists of running the soft pinion in mesh with a hardened mating gear while imparting a horizontal rocking motion to the pinion. The burnishing removes all tooth marks and small flats that may be produced in cutting the teeth. One gear can be used for burnishing a number of pinions, but it is sometimes necessary to try several gears before finding one with the right tooth finish for burnishing. The operation is not intended to compensate for careless gear-cutting, but to improve the best cut gear. The machine is capable of burnishing and average of one gear every 1.6 minutes. This operation was not performed before the installation of this machine.

Drilling Holes in Clutch Flywheels—Twenty-seven holes are drilled in the clutch flywheel by means of the "Natco" multiple-spindle machine illustrated in Fig. 12. This ma-

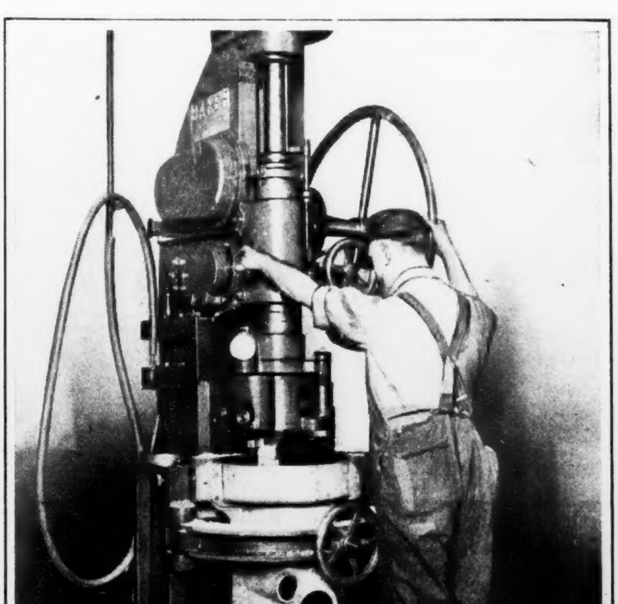


Fig. 19. Operation in which the Bell-housing End of the Crankcase is rough- and finish-bored, faced, and chamfered

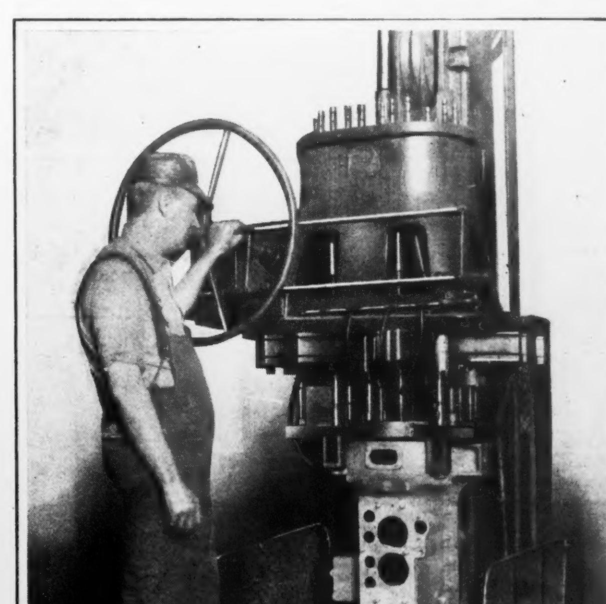


Fig. 20. Multiple-spindle Drilling Machine used for drilling Nineteen Holes in the Bell-housing End of the Crankcase

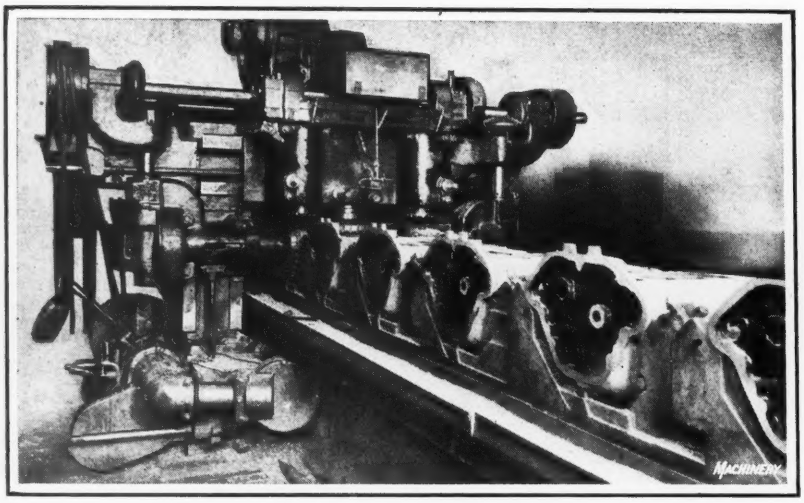


Fig. 21. Operation in which Eight Milling Cutters are employed for milling Various Surfaces on the Crankcases

chine is equipped with a 48-inch rotary table having three work-holding fixtures. In an operation, one station is reloaded while the work is being drilled at the other two stations. The drill head of this machine is also of the rapid-traverse type, operated through an automatic switch. One flywheel is completed every 3.07 minutes, which is an increase in production of 578 per cent over the old method.

Grinding Hole in Valve Lifter Rolls—In Fig. 13 is illustrated a Bryant internal grinder employed for grinding the hole in valve lifter rolls. In this operation, the average time is 0.62 minute per piece, which represents a 106 per cent increase in production over the method formerly used.

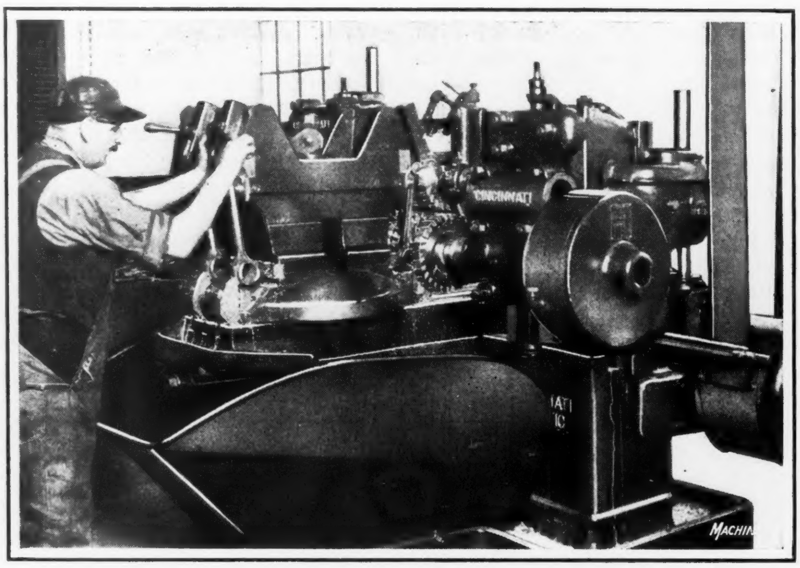


Fig. 22. Straddle-milling the Crank and Wrist-pin Bosses of Two Connecting-rods at One Time

Grinding the Pin-hole in Valve Lifters—A Bryant semi-automatic hole grinder is used for grinding the cross pin-hole in valve lifters, as illustrated in Fig. 14. Two machines and operators are used, the time per piece averaging 1.01 minutes. This represents a production increase of 88 per cent over the former method for each machine.

Drilling and Reaming Bolt Holes in Clutch Covers—In Fig. 15 there is shown another "Natco" multiple-spindle drilling machine used for drilling and reaming the bolt holes in the clutch cover. The machine is equipped with a 48-inch rotary table having three work-fixtures spaced 120 degrees apart. The operator reloads one station while drilling and reaming are being done on the work at the other two stations. This machine is also equipped with a rapid-traverse head driven by a motor on the left-hand side, as may be clearly seen, and operated by an automatic switch. One clutch cover is drilled and reamed complete every 1.31 minutes, the production increase over the former method being about 133 per cent.

Drilling the Arms and Flanges of Axle Housings—All holes in the arms and flange of the axle housing are drilled by means of the "Natco" multiple-spindle drilling machine shown in Fig. 16. This machine is also equipped with a rapid-traverse head operated automatically through an electric switch. The work is placed in a jig, which is revolved in a vertical plane, and then pushed horizontally along the base to permit the opposite end to be drilled. Either end may be drilled first. The average time per housing in this operation is 12 minutes, and the increase in production over the old method is about 12 per cent.

Drilling and Reaming Bolt Holes in Connecting-rods and Caps—The bolt holes in connecting-rods and caps are drilled and reamed under a "Natco" multiple-spindle drilling machine, as illustrated in Fig. 17. The work-fixture is of the three-station indexing type; hence, the operator can reload one station while drilling and reaming, respectively, are being performed on work held in the two remaining stations. The time required for an operation on a complete connecting-rod and cap is 3 minutes, which represents a production increase of 433 per cent.

Diamond-boring the Crank End of Connecting-rods—Fig. 18 shows a special high-speed machine designed by the White Motor Co. for diamond-boring the crank end of connecting-rods. The connecting-rod is centered and held vertically in the fixture by means of a cam-operated clamp. The diamond bit is rotated at 1540 revolutions per minute, and advanced 0.001 inch per revolution for removing from

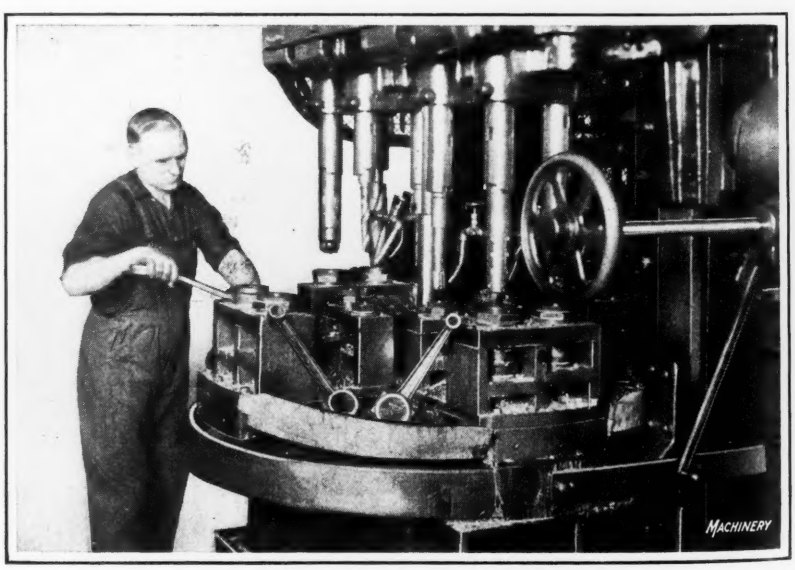


Fig. 23. Operation in which the Crank and Wrist-pin Holes of the Connecting-rods are rough- and semi-finish-bored in Two Steps

0.010 to 0.012 inch of stock. The time per piece averages 2.81 minutes, and the increase in production over the previous method is 106 per cent.

Milling Connecting-rod Bosses—The crank and wrist-pin bosses of connecting-rods are straddle-milled in the Cincinnati duplex automatic milling machine illustrated in Fig. 22. The time per rod is 0.80 minute, and the increase in production over the old method is 246 per cent.

Rough- and Semi-finish-boring the Connecting-rod Bearings—The crank and wrist-pin bearings of connecting-rods are rough- and semi-finish-bored in the Moline "Hole Hog" drilling machine illustrated in Fig. 23. This machine has a revolving table equipped with four fixtures, each of which holds two rods. The operator reloads one fixture while roughing and semi-finishing cuts are being taken on rods held in two of the others. The fourth fixture is at rest between the roughing and semi-finishing cuts. The production rate in this operation is one rod every 2.21 minutes, which constitutes an increase of 393 per cent over that obtained by the old method. In addition, one machine has been eliminated.

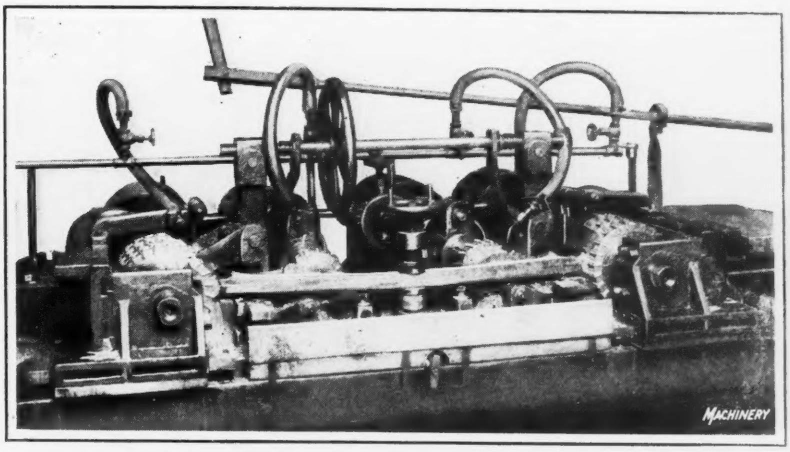


Fig. 24. Four-spindle Milling Machine equipped for milling Two Spring Pads and Eight Yoke Faces on the Front Axle Forging

Straddle-milling the Connecting-rod Bolt Bosses and Cutting off the Caps—The Cincinnati duplex automatic milling machine shown in Fig. 27 is used for sawing the cap from the crank end of the connecting-rods and for milling the bolt bosses. The machine is equipped with a 180-degree indexing base having a fixture mounted on each end. While rods are being milled in one fixture, the operator reloads the other. When a cut has been completed, the machine automatically returns the table, the operator swivels the base one-half a revolution and reclamps it, after which the operation is repeated. The time per rod is 2.06 minutes, which represents a 254 per cent increase in production over the former method.

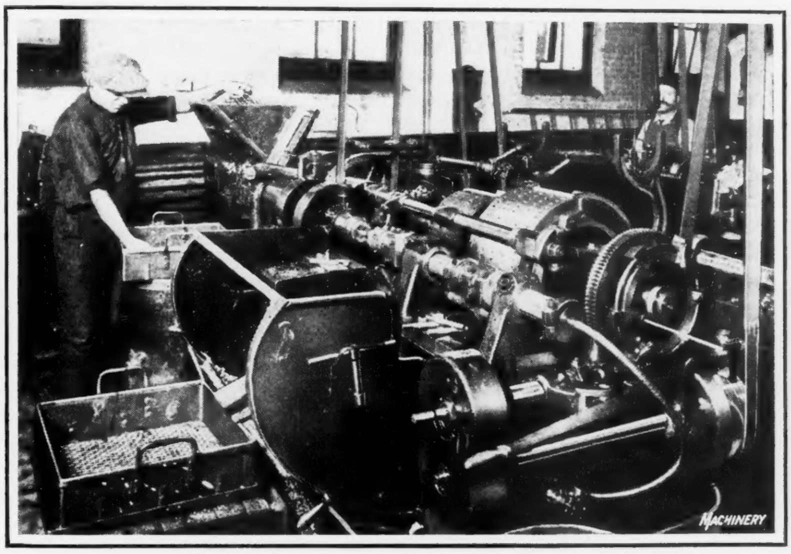


Fig. 25. Machine employed for automatically threading the Ends of Studs

Machining the Bell-housing End of Crankcases—The bell-housing end of the crankcase is rough- and finish-bored, faced, and chamfered in the Baker Bros. heavy-duty upright drilling machine illustrated in Fig. 19. This machine is equipped with a special boring and facing head, a cam feeding the facing tool radially. The time per piece for this operation is 12.54 minutes; while this represents a production increase of only 4 per cent over the old method, it is far more convenient.

Drilling Thirty-four Holes in the Crankcases—Nineteen holes are drilled in the bell-housing end of the crankcase and fifteen in the gear end, in two operations on "Natco" multiple-spindle drilling machines. The machine used in the first of these operations is illustrated in Fig. 20. At the foot of the machine may be seen a roller conveyor which provides a convenient method of transporting the casting between the two machines. Both machines are equipped with a rapid traverse head. Power for driving this head is obtained from an individual motor located on the left-hand side and operated by an automatic switch. A lever at the front of the machine is used to traverse, stop, or reverse the head at the will of the operator. One man runs both machines, and averages 3.95 minutes per casting—a production increase of 264 per cent over the old method.

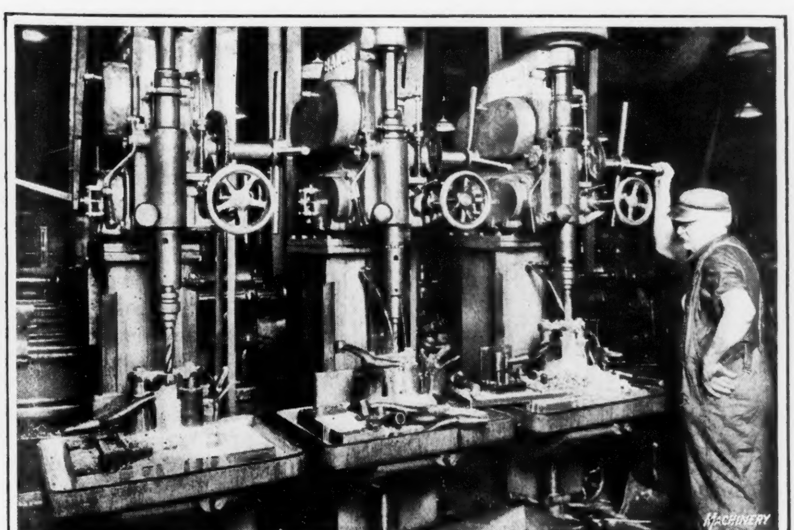


Fig. 26. Group of Three Upright Drilling Machines arranged for Three Operations on One Part or One Operation on Three Parts

Milling Crankcases—The Ingersoll milling machine illustrated in Fig. 21 is equipped with eight cutters for machining crankcases. The operation consists of rough- and semi-finish-milling the cylinder joint face, milling the top of the fan bracket lugs to size, and rough- and finish-milling both the rear and gear ends. The cut is started after two pieces have been placed in the fixtures, four more castings being loaded while the machine is operated.

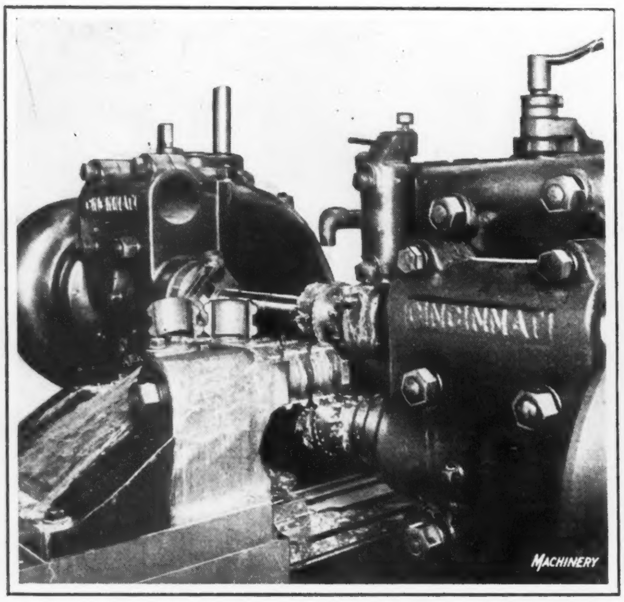


Fig. 27. Sawing the Cap from the Crank End of Connecting-rods and milling the Bolt Bosses on the Same End

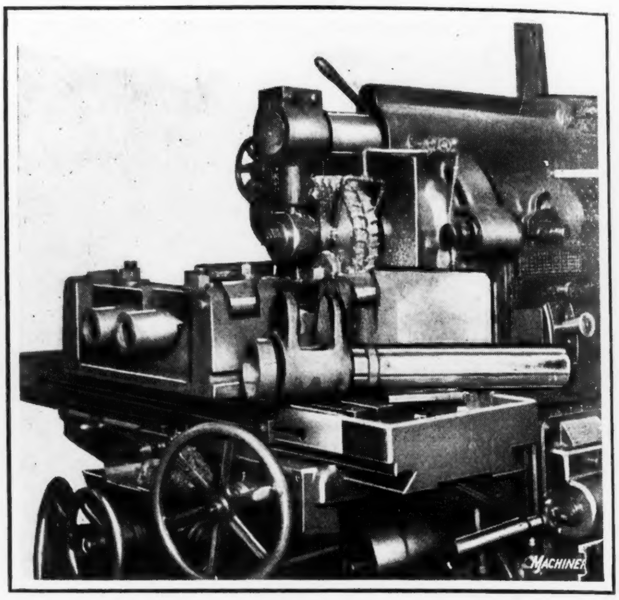


Fig. 28. Rough- and Finish-milling the Inner Faces of the Lugs on the Rear Axle Sleeves

At the end of the roughing cut, the clamps that hold the work are released, and the work is reclamped with a minimum pressure. The table travel is next reversed for taking the finishing cut. The castings are unloaded as soon as they pass the cutters and while the table is moving. One casting every 3.02 minutes is averaged, which represents a 445 per cent increase in production over the method previously used. One milling machine and one handling of the casting have been eliminated.

Assembling the Main Bearing Caps to Crankcases—The twelve main bearing studs are driven into the crankcase by means of a Hammond stud-setter, and after the main bearing caps are placed over these studs, nuts are driven on the studs by means of a Hammond nut-driver. The two machines are placed side by side, as illustrated in Fig. 11. The average time for the entire operation is 9.28 minutes per crankcase, the production being 99 per cent greater than by the previous method.

Milling the Yokes and Spring Pads on Front Axles—Two spring pads and eight yoke faces on the front axle forging are milled simultaneously in the Beaman & Smith four-spindle machine illustrated in Fig. 24. The time averages 8.83 minutes per axle, with an operator devoting only one-half of his time to the machine. The increase in production over the previous method is 48 per cent.

Threading Studs—Studs from 3/8 to 1 1/4 inches in diameter, having a threaded length of from 7/8 to 2 1/2 inches, are threaded in the Cleveland automatic shown in Fig. 25. The magazine of this machine is filled with blanks cut to length in a preceding operation, and these blanks are fed through the spindle to a collet type of chuck, which grips them securely for the operation. The thread is cut by a collapsible die-head, after which the stud is ejected from the chuck by the succeeding blank. The average time per stud is 0.22 minute, which represents a production increase of about 36 per cent. However, only three-eighths of an operator's time is required by the machine, whereas one man was kept busy constantly when the previous method was used.

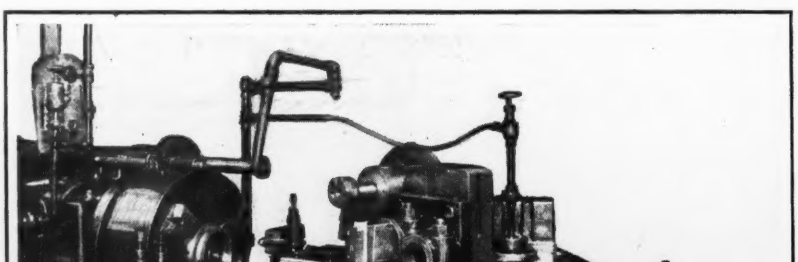


Fig. 29. Equipment provided on an Automatic for finishing Gear Blanks preparatory to cutting the Teeth

Miscellaneous Drilling and Reaming Operations—Four groups of Baker upright drilling machines, arranged as illustrated in Fig. 26, have been installed for drilling and reaming various parts. These machines are independent as to feeds and speeds, and may be run singly or collectively. Operations on three different parts or three operations on one part can be performed simultaneously with one operator. The average increase in production resulting from each group of machines is approximately 200 per cent.

Milling the Lugs on Rear Axle Sleeves—The inner faces of two lugs on the rear axle sleeve are rough- and finish-milled in horizontal milling machines, a Brown & Sharpe machine being illustrated in Fig. 28. In the roughing operation, a solid milling cutter is used, while in the finishing operation, two adjusting milling cutters are employed, as shown in the illustration, with a spacer of the proper width between them. One operator runs the two machines and produces a sleeve every 14.19 minutes. In addition to increasing production 240 per cent and eliminating an operator, the new method permits one operator to tend a drilling machine and effect a further saving of 6 minutes.

Machining Gear Blank Forgings—Various gear blanks are finished in Potter & Johnston automatics set up as illustrated in Fig. 29. As the machine is automatic in all of its functions, all the operator has to do is reload the air-operated chuck. The average blank is finished in 9.23 minutes, which represents a production increase of 79 per cent per machine. One man runs two machines.

Grinding Periphery of Ring Gears—The periphery of the rear-wheel ring gears is ground in the Landis cylindrical grinding machine illustrated in Fig. 30, this machine being equipped with a Garrison chuck which holds the ring gear by means of the teeth. There is a special

driving mechanism for reducing the work speed, and a special live-spindle headstock for the chuck. On one size of this gear, the average production is one piece every 8.12 minutes, and on another size, one gear every 6.96 minutes. These figures represent an average production increase of 67 per cent over the old method.

Determining the Hardness of Parts—The Brinell hardness test on various parts is performed on the Tinius Olsen lever-type testing machines shown in Fig. 31. The pressure necessary for the operation is obtained through the medium of a weight actuated by air pressure. A production increase of 400 per cent has been attained with these machines over the old method of conducting the test.

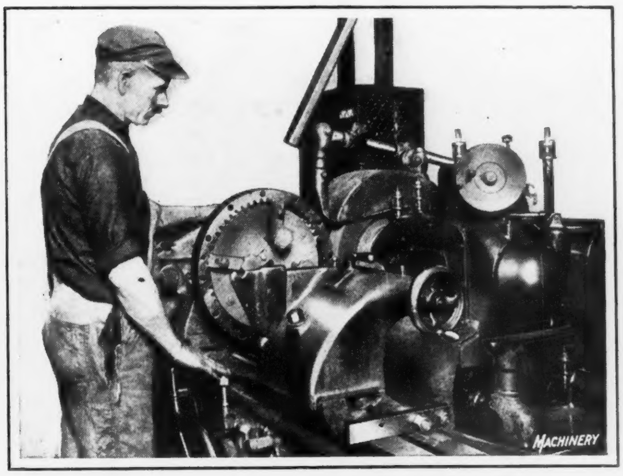


Fig. 30. Set-up of Machine employed for grinding the Periphery of Rear-wheel Ring Gears

* * *

THE ROMANCE OF AN ELECTRICAL GENERATOR

The story of the building of an 80,000-horsepower turbine-generator, of which nine will be installed in the East River Station of the New York Edison Co., is truly a romance of engineering. Its construction was started over a year and a half ago in the Schenectady Works of the General Electric Co. under the direction of men who thirty-five years ago worked on a 45-horsepower generator, then one of the largest in the world. One hundred eleven different materials are used in the construction of these machines, and these had to be carried by practically every known means of transportation—from the shoulders of peons, and elephants' and camels' backs, to the giant steamships and modern trains that finally delivered them at the Schenectady Works.

The copper ore was mined and smelted in Montana, refined in New Jersey, and drawn into wire in Rome, N. Y. The silk covering some of the wires came from China. Other wires are covered with a compound of rubber from Ceylon, mixed with zinc oxide from Missouri, whiting from France, and sulphur from Sicily. Still other wires defy heat with a covering of asbestos mined in Quebec and refined and spun into yarn in New Jersey. These wires are wound into coils and covered with cotton tape. The cotton was picked in Texas, spun in North Carolina, woven in Pawtucket, Rhode Island, and was given a finishing treatment in Utica, N. Y., before arriving at the electric works.

The coils were then soaked in a varnish compounded of copal nubs from the Philippines or kauri chips from Singapore. To these ingredients are added raw umber from Turkey, and linseed oil from flaxseed grown in the Argentine Republic. To these are added China wood oil from China, spirits of turpentine made in Georgia, and petroleum products from Oklahoma, refined in Texas or New Jersey.

The iron in the motor was made from Minnesota ore, smelted in South Chicago with Michigan limestone and coke made from Pennsylvania and West Virginia coal. The metal for the bearings in which the motor shaft rotates contains tin from Singapore, antimony from China, and copper from Montana. The armature is made up of hundreds of sheets of special silicon steel, little thicker than a sheet of heavy wrapping paper. The ends of the wire are fastened together with solder made of lead from Colorado mixed with tin from the East Indies. The terminals are coated with shellac, deposited by tiny insects on the twigs of trees in India, and dissolved in grain alcohol denatured with wood alcohol from Michigan.

After the coils are covered, soldered, and shellacked, the rotating part is bound with phosphor-bronze wire. The ingredients of this wire traveled almost 16,000 miles; from Montana, the copper traveled 2745 miles; the zinc came 2000 miles from Oklahoma; the tin, 11,000 miles from Singapore, and the finished wire was then brought 314 miles more to the electric works.

* * *

STANDARDIZATION OF SMALL TOOLS

The Society of Automotive Engineers has recently accepted joint sponsorship for the committee on the standardization of small tools and machine tool elements, organized and also sponsored by the American Society of Mechanical Engineers and the National Machine Tool Builders' Association under the procedure of the American Engineering Standards Committee. Inasmuch as the work of the sectional committee, which is planned on a national scale affecting all machine tool using industries, will relate directly to that of the production division of the standards committee, the society's representatives on the sectional committee will be selected from the division. LeRoy F. Maurer, who is a member of the division, has been serving for some time as the society's representative on the sectional committee and subcommittee No. 1 thereof on T-slots and parts. The other subcommittees of the sectional committee so far appointed are those on tool-holders and toolpost openings and on machine tapers.

The subcommittee on T-slots and parts has made a tentative report, copies of which have been sent to the members of the production division for criticism. As reports of the sectional committee are submitted later on to the sponsors for approval, they will be assigned to the production division for consideration and recommendation to the standards committee and society members in the same manner as the society's regular standards. The report includes dimensions for T-slots, bolts, nuts, and cutters.

Fig. 31. Testing the Hardness of Parts by Means of Lever-type Machines based on the Brinell Principle

What MACHINERY'S Readers Think

on Subjects of General Interest in the Mechanical Field

THE VALUE OF SHOP VISITS

It was with a great deal of interest that I read the editorial on shop visits on page 864 of July MACHINERY, as I thoroughly agree with the views there expressed.

For the last twenty-three years I have been foreman of a railroad shop, and have often been given an opportunity by the management to visit automobile, railroad, machine tool, and other machinery-building shops in different parts of the country. During these visits I have studied their equipment and operation with a view to obtaining the best results in our own shop by introducing effective production methods. These visits have been most helpful to the writer, and in almost every case he has found other manufacturers willing to extend the courtesy of showing him their plants.

Many foremen and designers have undoubtedly much to learn from other shops, and most of them recognize this. There are, of course, a few who "know it all," and who keep on knowing it all until they become back numbers. In the writer's opinion, one of the most helpful examples of visiting other shops is to be found in the railroad field. It is of great value for a railroad shop foreman to visit not only other railroad shops, but also production shops, like automobile plants. While there is not the opportunity for real quantity production in engine or in passenger and freight car construction and repair that there is in automobile plant practice, nevertheless, many ideas can be picked up by the wide-awake railroad shop foreman in an automobile plant.

It will pay a railroad to encourage its superintendents of motive power, master mechanics, and foremen to visit manufacturing plants, and occasionally automobile-building plants, to get an idea of methods and operations different from those regularly used in railroad shops. There are many machines not generally used in railroad shop practice that could be advantageously employed in these shops, and to gain knowledge about these machines, shop visits are very helpful. In the writer's experience, many new machine tools have been installed to advantage in his own shop as a result of visits to other plants. With these new machines, the work has been performed quicker and cheaper. E. A.

* * *

ACCURACY VERSUS GENERALITIES

There are too many generalities and too little accurate information back of many managerial problems. It seems like nothing but fault-finding to a foreman, if the manager tells him that he thinks the general efficiency of his department is low. On the other hand, there can be no resentment, if the manager can say, "Last month with twenty-eight men working, your department turned out fifty-one units; this month with thirty men at work, only forty-seven units were turned out; what's the reason?" Then the foreman will immediately try to find the actual cause of the shortcoming and determine whether the trouble is due to something within his power to remedy or not. At least it will be properly understood, and ways and means can be found either by the manager or the foreman himself to increase the efficiency.

The same is true in regard to the relation between a foreman and his men. Generalities should be avoided. They carry no weight unless backed by definite facts. Furthermore, these facts must not be stated without a due appreciation of other conditions that may have a bearing upon the case. On one occasion, a foreman found fault with the men because they did not make proper headway with their work. The reason that the men were unable to make headway was that the foreman insisted that they follow his instructions implicitly, and, unfortunately, he was not capable of directing them to do the work in the best and most efficient manner; yet he would not let them use their own judgment. As a result, the work fell behind. J. S. G.

* * *

WRITING TECHNICAL ARTICLES

It is claimed that engineers, in general, lack the ability to write, clearly and concisely, articles or scientific papers pertaining to their particular line of work. Draftsmen, superintendents, foremen, machinists, toolmakers, and diemakers are not excepted in this claim. What an interesting accumulation of valuable data would be accessible to posterity, were all adept at expressing their thoughts and experiences. Writing, like all other accomplishments, improves with constant application. The mind expands by the expression of opinions; the weak spots therein become manifest, and are strengthened through research and the criticism of others. Writing calls for a systematic arrangement of views and a weeding out of non-essentials. Have a subject to write about, then concentrate your efforts upon putting the thought before the reader in the least possible number of words.

Mechanically inclined men are too busy to waste their time in reading unnecessary material. If an article is worth writing at all, it is worth writing well; slipshod methods may go in speech, but writing calls for clean, clear-cut procedure. Remember that your name stands behind the article written. Writing mechanical articles necessitates the making of drawings, or sketches, occasionally, to accompany them. Many a good article has been lost in the first stages of thought, simply because the conveniences were not at hand to put the article in acceptable form. With proper facilities, one is likely to prepare articles that otherwise would not be attempted.

One is often inclined to comment upon an article written by another; in such a case, nothing but the highest respect should be shown in the criticism; lack of courtesy will not be tolerated by editors. Writing articles will train one to observe more closely, improve the expression, and develop a habit of personal betterment. Writing teaches one how to punctuate, spell, avoid slang, and enlarge the vocabulary.

Be a regular subscriber to a journal pertaining to your line of business, and be a living member of it by contributing your share of thought to its pages. Don't be content to let the other fellow do the work; be an active spoke in the wheel of progress. JOHN HOMEWOOD

* * *

WHAT HAPPENS IN RAILROAD SHOPS?

Next to the automobile industry, the locomotive building plants and the railroad shops constitute the second largest group in the machine shop field. Yet, while the engineers in automobile shops frequently discuss their problems and exchange ideas in the technical press, the men in the railroad shops seldom put down their ideas in writing for publication. Nevertheless, there are many men in the railroad field who are constantly devising new methods of performing work and whose ideas on railroad shop problems would be of great interest to men in other machine building fields, as well as to those in their own line of work.

At this time especially, when the railroads have once more gained a reputation for efficiency and ability to cope with heavy traffic, the improvements in railroad shop practice would be of especial interest. Men in that field who have some interesting practice to record could benefit others by submitting it for publication. RAILROAD SHOP FOREMAN

MANOGRAPH

The manograph is the name of an instrument used for indicating engines of very high speed. It consists principally of a small mirror moved or tilted upward and downward by a diaphragm actuated by the pressure variations in the cylinder. The mirror is also rocked from side to side by a mechanism geared to the engine, in order to reproduce the reciprocating motion of the engine piston on a smaller scale. The principle of action of the device is based upon the fact that a beam of light is reflected by the mirror on a ground-glass screen, and this beam, by the movement of the mirror, traverses a path corresponding to that of the pencil point of an ordinary indicator. The diagram is traced by the beam of light on the ground-glass screen, and varies with the varying conditions in the cylinder. A photographic dry plate in a plate-holder may be substituted for the ground-glass screen, and the diagram may thus be photographed. The exposure varies from one-half to three seconds. The instrument is especially used on gas engines, where the speed is too high for the ordinary type of indicator.

MOLYBDENUM

Molybdenum is one of the metallic chemical elements, the symbol of which is Mo, and the atomic weight, 96. The metal is related to chromium, tungsten, and uranium, and is obtained in the form of a powder of gray color. Pure molybdenum, in its powder form, has a specific gravity of 9.01. It is malleable, but of great hardness, although not so hard as glass. Molybdenum is found in nature chiefly in the mineral molybdenite, and is also present in many iron ores. It is used principally in making alloy steels.

PUMP VALVE LIFT AND AREA

In the design of pump valves, the combined area should be large enough to prevent excessive velocity and friction when the water or other liquid is passing through the valve seat; the suction valves should open easily and with little pressure, as otherwise, the atmospheric pressure would not overcome the resistance, especially if the vertical height from the source of supply to the pump cylinder were considerable; the lift of the valves should be small, to prevent excessive slip or leakage while the valves are closing; the valves should close rapidly, be tight when closed, durable, and easily replaced. Evidently there must be a compromise in the design of valves. For instance, stiff springs would close the valves quickly, but increase the pressure required for opening them; a high lift would be conducive to a free flowing movement of the water, but a low lift is desirable to prevent excessive losses through slip; large conical seats would provide straight passages for the water and reduce the frictional resistance to the flow, but would require large heavy valves and high lift. The general practice is to use a number of small valves and flat seats instead of the conical form, in order to reduce the amount of lift, although conical seats are sometimes used in connection with wing valves, etc. The lift of disk valves is usually about 1/4 inch, regardless of the diameter. A wing valve having a 45-degree seat requires 40 per cent more lift than a flat valve to obtain a corresponding area of opening. The total valve area usually varies from 45 to 50 per cent of the plunger area, although it may be as low as 30 per cent and as high as 60 per cent, depending upon the speed at which the pump is to operate. The maximum velocity of the water while passing through the valves should be about 225 feet per minute. By "valve area" is meant the area of the unobstructed opening or free passageway through the seats.

DRUMS FOR WIRE ROPE

The drums used for wire ropes should be grooved rather than flat. The grooves should be so spaced on the drum that there is ample clearance between the successive windings on the drum. For example, a drum for a 1-inch rope should have the centers of the grooves at least 1 1/16 inches apart. If the groove is made in this manner, the successive convolutions of the rope will not rub against each other. The grooves of all sheaves and drums for wire rope should be smooth, so that they do not cause abrasion to the rope wound upon them. The grooves should also be of a slightly larger radius than the radius of the rope, so that there will be no wedging or pinching action. If possible, the drum upon which a wire rope is wound should be wide enough so that the rope may be wound upon it in one layer. It is bad practice to wind the rope upon the drum several layers deep. The respective layers of the rope will wear against each other and the life of the rope will be considerably shortened. When there is not space enough for a large drum, flat wire ropes, which may be wound in successive layers, are often used.

TURBINE TYPE OF WATER-WHEEL

A water turbine may be of vertical or horizontal design. The horizontal turbine may be provided with a casing and be located in the generating room, or it may be of the submerged type and be located in a basin contiguous to the generating room, with the shaft extending through the dividing wall to the generator. The submerged turbine is used only on very low heads, but in some cases it lends itself to an economical and advantageous design of station. The vertical turbine is particularly well adapted for large units. It takes considerably less floor space and, consequently, smaller foundations than the horizontal type. The vertical turbine necessitates the use of a step bearing; recent designs of such bearings for this purpose have proved quite satisfactory. The manufacturer of water-wheels is in the best position to make recommendations as to which type of wheel is most desirable for any particular head and capacity. Sometimes the design of the generator is a determining factor, and the solution of this problem is best solved by the manufacturer of generators.

MANGANESE-BRONZE

There are a number of different manganese-bronzes which give satisfactory results. They generally contain from 56 to 60 per cent of copper, from 37 to 42 per cent of zinc, with small percentages of iron, tin, and manganese. The manganese content is not more than 0.3 per cent, and sometimes it is as small as 0.01 per cent. Nevertheless, it has a considerable influence upon the character of the alloy. Tests made indicate that the ultimate tensile strength of castings made from manganese-bronze of the composition mentioned is about 60,000 pounds per square inch, with an elastic limit of 30,000 pounds per square inch. Rolled manganese-bronze has a tensile strength up to 100,000 pounds per square inch, with an elastic limit of about 80,000 pounds per square inch. The elongation in rolled samples varies from 12 to 15 per cent, and in sand castings, from 8 to 10 per cent. The compressive strength of cast manganese-bronze varies from 125,000 to 135,000 pounds per square inch. Wrought manganese-bronze differs chiefly from the casting grade in being free from aluminum. The addition of aluminum enables the alloy to be cast satisfactorily in sand molds. In order to secure ductility as well as high tensile strength, extreme purity of the materials used is absolutely essential.

THE HOPEFUL INVENTOR

America's vast army of inventors is ever active. The millions of hours and dollars spent (and often wasted) annually in the efforts of amateur inventors will never be known; and, strangely enough, a large portion of the losers are regularly employed in mechanical occupations with unusual opportunities to find out what is practicable, and to learn of the best means to proceed.

It has been my lot to manage a factory and to develop personally several modestly profitable inventions, but I experience no ardent fascination for tinkering. In any event, this rather indifferent interest has enabled me to study in a disinterested manner the aspirations of many struggling inventors. There is seldom a week in which I am not approached by at least one radiant optimist who believes he is on the trail of great riches.

It would be manifestly unfair to encourage the man whose effort seems wholly without merit. On the other hand, it is no pleasant task to puncture his shimmering bubble of hope and dreams.

Many of our valuable inventions are developed by highly trained men employed in scientifically conducted laboratories and in the experimental departments of large companies; but it is equally true that much real genius and many splendid ideas spring from the amateur class of inventors. Mankind has profited much from the accomplishments of these untrained experimentors. They well deserve encouragement, but it should be of the kind definitely tending to make their work successful instead of a foolish waste of time and dollars.

Inventing and Developing Devices Already Worked Out by Others

Not long ago a young man came to me with a can-opener. "You're the second person to see it," he declared. "Now notice how easily it works." He drew a can from his pocket and applied the instrument. Its operation was perfect.

"How long have you worked on it?" I asked.

"Oh, several months, in spare time. Guess I made a couple of dozen before I got round to this one."

"Well," I ventured, "it is probably one of the best types of can-openers ever developed, and I'll tell you why I think so. As a boy it was often my duty to open cans. The instrument I used did the work splendidly, and it was almost an exact duplicate of yours."

He was surprised, of course, and just a bit incredulous; but after a while he laughed off his disappointment and told me of another kitchen appliance upon which he proposed to do some experimenting. I praised his ingenuity, and then I offered him this general advice: "Your error in this case lies not in the device itself, but in your failure to investigate, and in your excessive secretiveness. You should have first studied the types of can-openers on the market. Such investigation nearly always leads to improved ideas.

Preliminary Protection of an Idea

"At the same time it would have been advisable to make a rough drawing of your device. This drawing should have borne the date and any brief description necessary for clearness. Then you should have had it signed by several reputable people, each of whom should have dated his signature. If important improvements were made, the same procedure could have been repeated. This would prove the date of invention, and is usually safer than the restrictive barriers of secrecy. When conflicting claims of priority arise, the mere word of the inventor is not enough. The Patent Office demands corroboration in proving the date of invention. Also, you should remember that the Patent Office allows you two years to apply for your patent after the first public use or sale of the device. If you wait longer than two years, your invention becomes public property.

"But, getting back to the can-opener—your next step should have taken you to your patent attorney for a brief, frank discussion of the matter. It is probable that he would have advised a preliminary search of the Patent Office for devices similar to the one shown in your rough sketch. Such searches usually cost about $10, and, although not so extensive as the Patent Office searches when passing on claims, they frequently save the inventor much time and money."

The young fellow went promptly to work on the other device. No patent has yet been granted to him, but he has declined an offer of $2500 for his claims.

How many thousands of other amateur inventors would profit by this young man's experience? How much time and money would be saved if these amateur inventors, and their financial backers, could be induced to realized the dangers of secretiveness? Inventions are rarely stolen from energetic inventors.

The Value of Other People's Suggestions

I recall the case of a man who spent five hard years developing a ditch-digger. He showed it to no one until he was ready to apply for a patent. His attorney was well informed in mechanical matters and, perhaps, a bit brusk in his criticisms. "Why don't you cut out all this complicated monkey-business for advancing the arms?"

"Why," faltered the elderly inventor, "it is absolutely necessary. I've spent most of my time perfecting this feature."

The attorney grunted. "Nonsense! Gear it to a track and advance the whole machine."

The old gentleman was at first speechless. "I believe you're right," he then admitted; "but why didn't I see it before? You don't know what that feature has cost me in money and worry these last few years."

Whether the device was worthless or good, the fact remains that too much secrecy robbed this old gentleman of considerable comfort and money in his declining years.

I have in mind another recent and simple case to illustrate this point. An automobile salesman asked me to make and market for him a neat, clever, inexpensive little device for holding display cards in windows and show-cases. It was merely a thin, flat spring looped in a peculiarly effective way. He forced the straight end into the crack between the glass and frame. The other end held the card.

"I sent one to a firm of patent attorneys and they tell me it's pretty certain I can get a patent. Also," he added, "I've just gone to considerable expense in getting the dies made for regular production. I'm going to apply for the patent right away, so I guess it won't hurt to let people see the thing."

"Do you mean," I asked, "that the dies are made without provision for punching a hole in the straight end?"

"Why a hole?" he asked.

"Why? So it can be tacked up anywhere and used for other purposes—for bulletins, time-cards, anything."

"Say!" he exclaimed; "that is what is needed." The idea had never occurred to him; but had he shown the device to half a dozen interested people it seems certain that some of them would have suggested the improvement.

The Cost of Manufacture, Selling and Distribution Seldom Occurs to the Inventor

This fault of great secretiveness is not the only error in the reasoning of most amateur inventors. Cost of manufacturing is another. Sales expense, the importance of making things fool-proof, packing and shipping costs, the changing requirements and whims of the public—these are all important. The inventor considers some of them, but he rarely gives sufficiently careful thought to all.

A good mechanic showed me an automobile shock absorber of his own invention. By special arrangement with his employer, he had for eighteen months been taking every Saturday off. He used these Saturdays, plus his Sundays and most of his evenings, to develop the device. Eighteen months of this—and in less than eighteen minutes he was convinced that even though the article appeared to be excellent in its operation, it simply could not be made and sold at a price within reason.

"I didn't realize what overhead expenses amount to and what it costs to sell," he said. "Could you give me some simple rule for estimating these things?"

"Bill, no simple rule could be correctly applied to all the different classes of merchandise and the many different circumstances surrounding their manufacture and sale. However, let us consider an article in the auto accessory class retailing at $10. The jobber's discount and freight allowance average about 60 per cent. This leaves $4, of which the representative who calls on the jobber gets an average of 10 per cent. You are already down to $3.60, from which must be deducted an allowance for taxes, insurance, bad accounts, cost of samples and displays, printed matter, advertising bills, special traveling expenses, office salaries, and all other general office overhead, plus the inevitable and many unexpected expenses. Assume that all these things amount to $0.60—just $3 is left. If the initial cost of dies, patterns, and jigs is not forgotten in fixing the total cost of materials, labor, and factory overhead at $2, then you have a net profit of exactly $1 remaining. And note that the retail price is five times the factory cost. In some cases it will be higher; in others lower."

Patents Applied for to Gain Prestige

Just as there are many types of men, so are there many types of inventors. Let me mention one species that regularly contributes its bit to the losses—the misguided fellows who believe it is a mark of genius and honor to be granted any kind of patent. I once met a pleasant man in the office of my patent attorney. He hailed from a small town, and wore a brown derby and plaid vest decorated with a handful of lodge emblems. He had just invented a portable fire-escape. It filled an over-size suitcase and would easily have wilted any herculean red-cap porter in the land. What he expected anyone to do with the device I don't know, but when questioned on this point, his answer was: "Oh, well, just go ahead with the application anyhow. I sort of figure that a patentee gains some standing in his community."

Forty years ago the total of all patents issued was around 345,000. The following ten years added approximately 220,000; the next ten, 260,000; then, 360,000 and 400,000, bringing the total to about 1,585,000 at the middle of this year. In 1925 there were 84,525 applications filed, but only 46,450 patents issued. Another ten years should find the total well above 2,000,000.

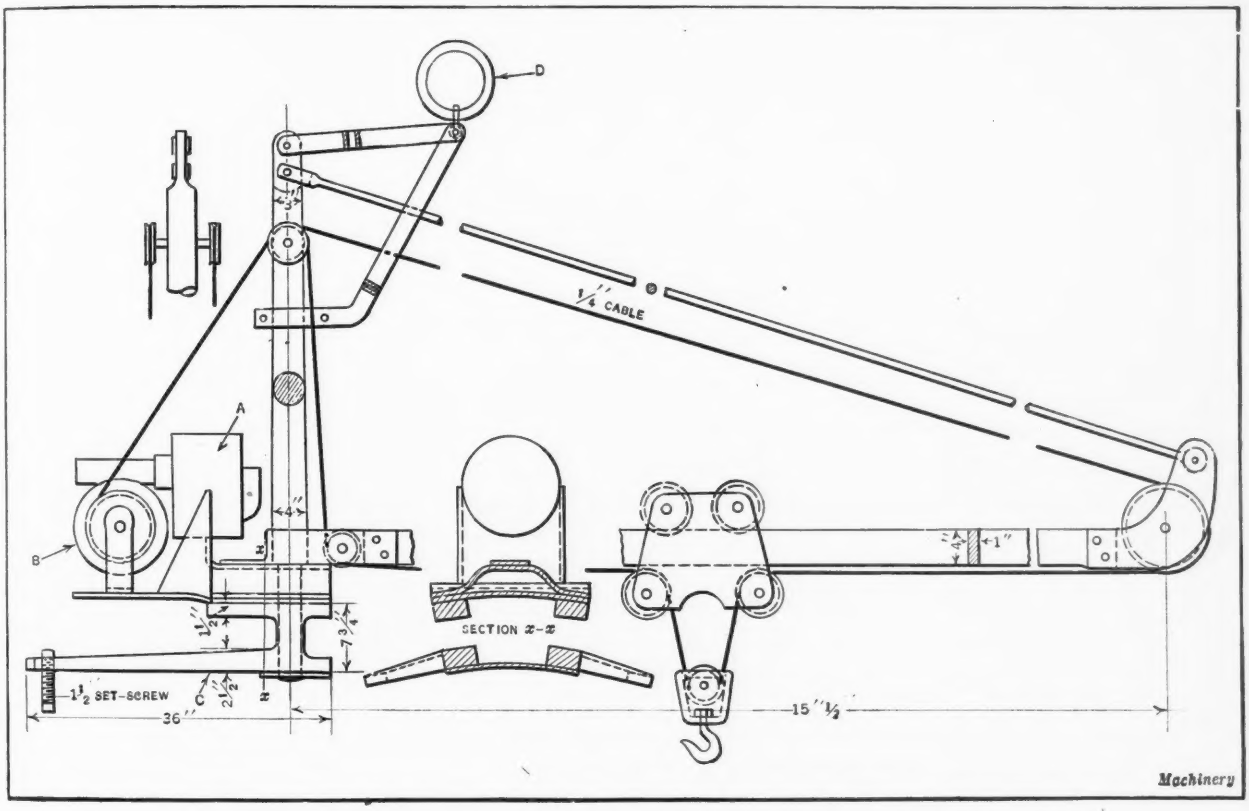
It is estimated that about one-third of the applications filed never mature into patents, but in these cases the inventive energy and expense remains the same. Likewise, we must remember the still greater amount of experimental work that fails to justify a patent application.

* * *

HOIST FOR SUPERHEATER UNITS

By J. R. PHELPS, San Bernardino Shops, Atchison, Topeka & Santa Fe Railway

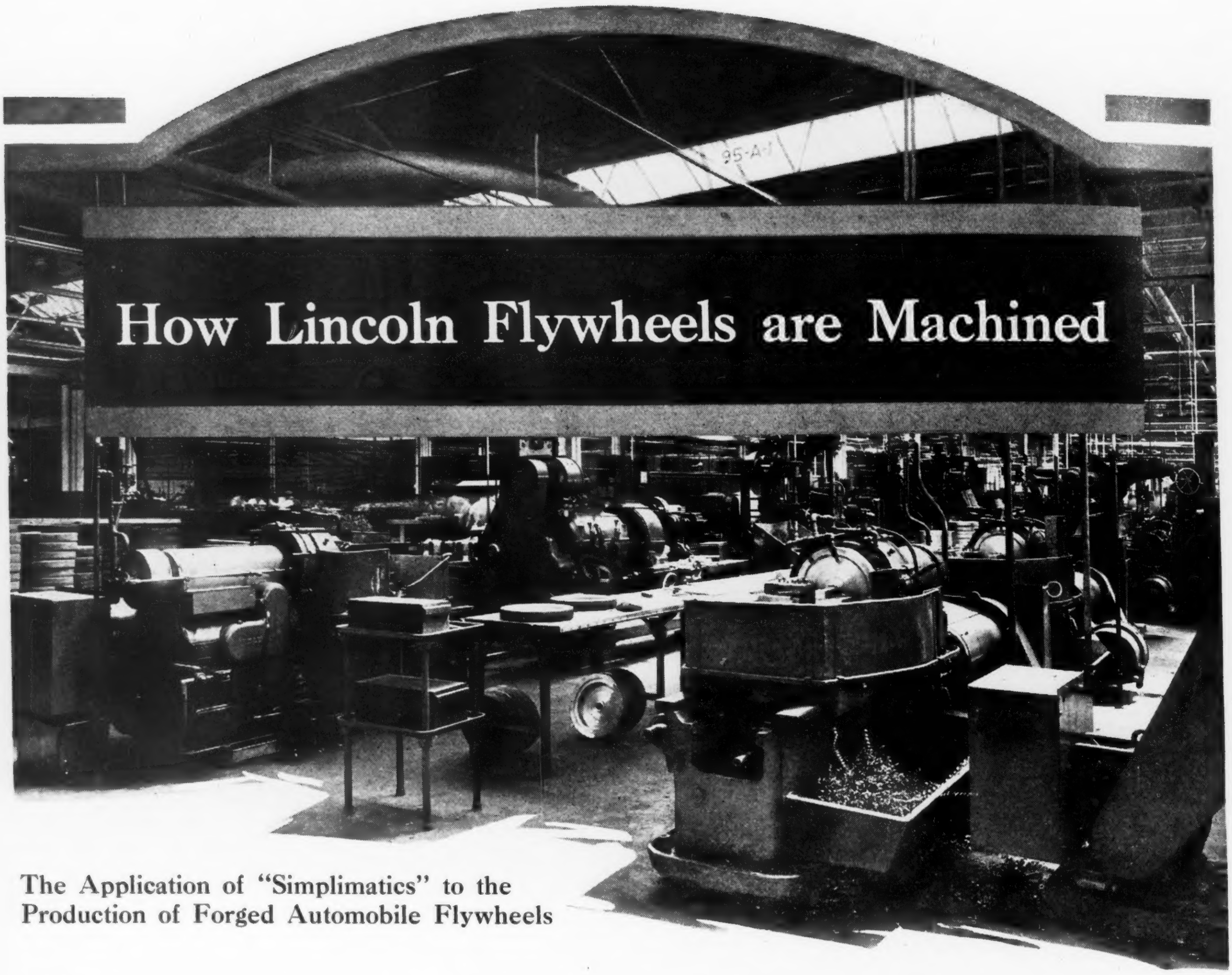
An air-operated hoist for removing and replacing superheater units in the front ends of locomotives is shown in the accompanying illustration. The air motor *A* and double drum *B* is a commercial product ("Little David" hoist, size 1000, Ingersoll Rand Co.), and the rest of the apparatus was designed for the particular work mentioned. The baseplate *C* rests on the smokebox just in front of the smokestack, and the hoist is braced from the top of the stack. One man in the smokebox can operate the hoist, and use of the large overhead shop crane is avoided, thus releasing it for other work about the shop. In lifting or lowering the hoist itself, the hook of the overhead crane engages ring *D* which is located so that the hoist when suspended remains in a horizontal position. This hoist was designed by F. B. Harmon, assistant superintendent of shops.



Pneumatically Operated Hoist which is mounted on Top of Smokebox and used for lifting Superheater Unit

* * *

The St. Louis-San Francisco Railway is said to save a million dollars a year in its reclamation plant at Springfield, Mo. The Division of Simplified Practice of the Department of Commerce points out that this is one of the six ways for industry to cut down the waste pile. The other five are: (1) The reduction of waste by closer supervision of materials, reduction of spoiled work, and a saving of power and fuel; (2) more efficient use of existing facilities through the elimination of idle machines, idle men, and idle materials; (3) better use of existing facilities through rearrangement of equipment to eliminate unnecessary handling; (4) simplification and standardization of product; and (5) better control of production costs by constantly watching for waste in materials, time, and effort, and the application of corrective measures.



How Lincoln Flywheels are Machined

The Application of "Simplimatics" to the Production of Forged Automobile Flywheels

THE flywheel for the Lincoln car is finished all over from the rough in five minutes, floor-to-floor time, by four machines and two men at the plant of the Lincoln Motor Co., Detroit, Mich. With this equipment, an average production of ten flywheels per hour is maintained. The flywheel is a steel forging of the construction illustrated in Fig. 3. Three of the machines used are "Simplimatics" built by the Gisholt Machine Co., Madison, Wis., and the other one is a Lodge & Shipley 24-inch engine lathe, which is employed for finishing the inside of the rim in the fourth operation. Before this method of handling the flywheel was introduced, it was the custom to purchase the flywheel rough-turned. Then three turret lathes, an engine lathe, and four men were necessary to finish the flywheels in the required time.

With the exception of the tool-slides, the "Simplimatic" is built as a standard machine, regardless of the job for which it is intended, but each tool-slide can be arranged in any required position on the table, fed in any direction at the proper rate, and equipped with tools suitable for the work to be machined. The tools are arranged for taking a large number of cuts simultaneously, and an operation is so divided that the rate of production depends on the time required for taking the longest cut. When the longest cut consumes far more time than any other, it is frequently taken by two or more tools so as to reduce the production time.

The feed used on the tool-slides may be varied by means of change-gears which are selected to suit the work. The

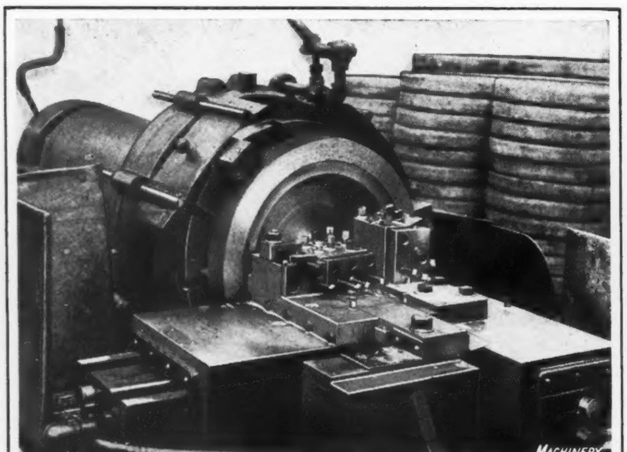


Fig. 1. Tooling Equipment provided on the "Simplimatic" for the First Operation on the Lincoln Flywheel

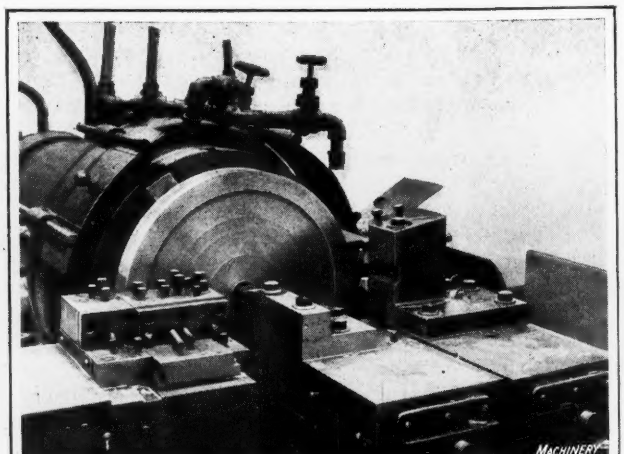


Fig. 2. Turning, facing, and boring the Closed Side and Periphery of the Flywheel in the Second Operation

actual feed of the slides is accomplished by means of cams, and can also be varied by designing the cams to suit conditions. Various spindle speeds are obtainable by means of change-gears. The flexibility of the tooling and the means of feeding the slides, gives, in effect, a machine designed for each particular job.

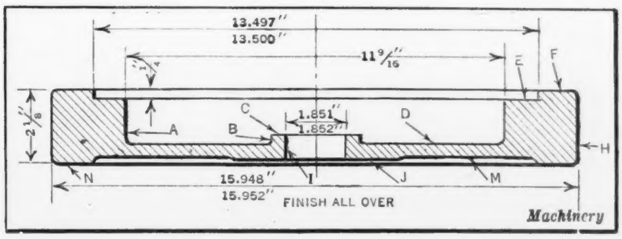


Fig. 3. Sectional View of the Lincoln Flywheel, showing Important Dimensions

Fig. 1 illustrates the first operation on the flywheel, and Fig. 6 shows diagrammatically the lay-out of the tooling employed. In the latter illustration, the surfaces machined are

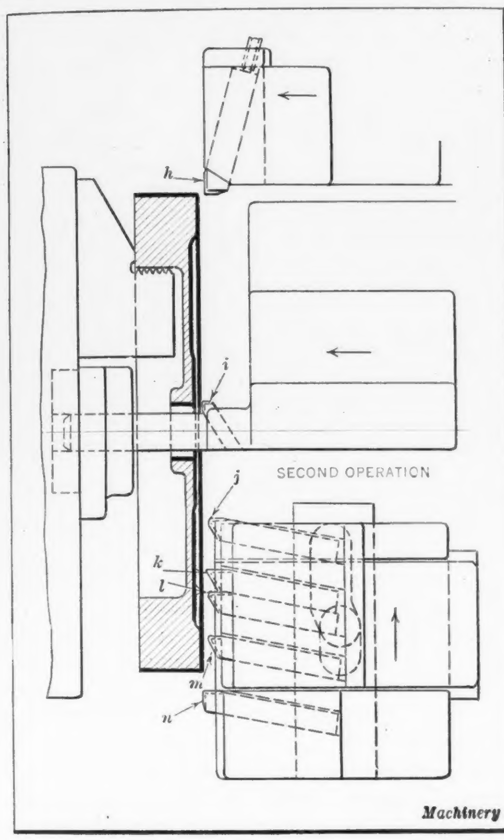


Fig. 4. Arrangement of Tooling on Machine shown in Fig. 2

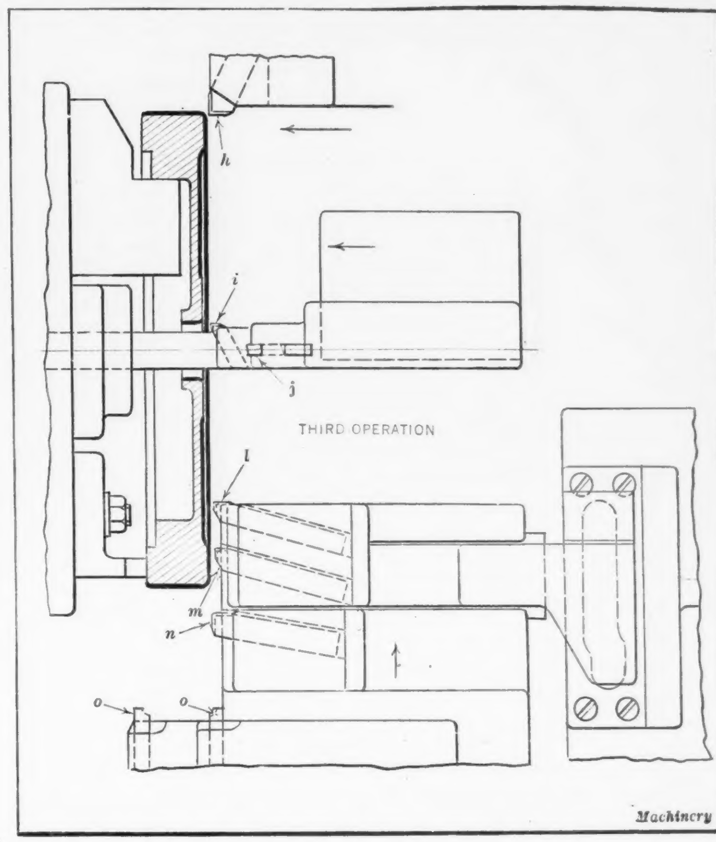


Fig. 5. Lay-out of Tooling provided on Machine employed in Third Operation

indicated by heavy lines. It will be obvious that as the rear tool-slide is fed longitudinally toward the headstock of the machine, surface *A*, Fig. 3, is machined by tool *a*, Fig. 6; and hub surface *B*, Fig. 3, is turned by tool *b*, Fig. 6. At the same time, the front tool-slide is fed toward the front of the machine, causing tool *c* to face surface *C* of the hub. After this surface has been passed, block *x* which holds tools *c*, *d*, and *e* is fed to the left sufficiently, irrespective of the slide, to make tools *c* and *d* face surface *D*, and to cause tool *e* to face surface *E*. With the same movement of the front slide, surface *F* is rough- and finish-faced, respectively, by tools *f* and *g*. The chuck jaws grip periphery *H* to hold the flywheel securely for the operation.

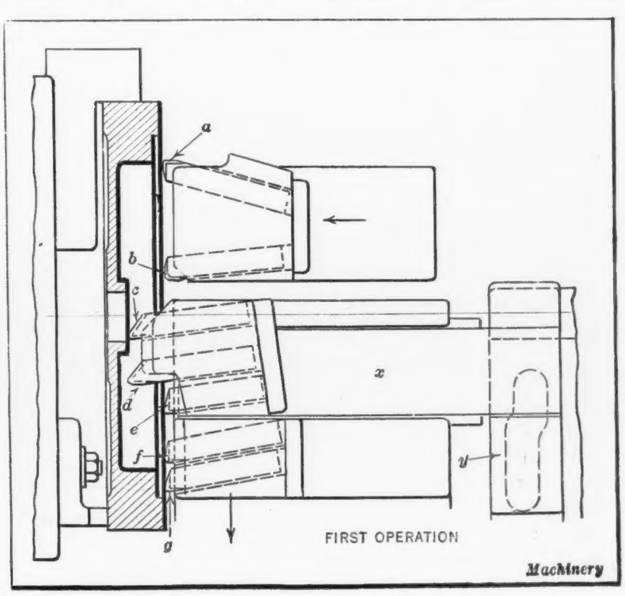


Fig. 6. Tooling provided on Machine illustrated in Fig. 1

The movement of block *x* which brings tools *c*, *d*, and *e* in line with the surfaces they face is accomplished by means of a roller attached to the block. This roller travels in the cam groove *y*, which is machined in a stationary base over which the tool-block moves. The result is that both the roller and tool-block *x* are fed to the left as the slide advances toward the front of the machine. In this operation, the longest cut is obviously the machining of face *D*. Tools *c* and *d* reduce the time to one-half that which would be consumed in machining this surface if only one tool were used. Seven tools cut simultaneously in this operation.

A view of the machine employed for the second operation is shown in Fig. 2, while Fig. 4 illustrates the lay-out of the tooling with which the machine is equipped. In this operation, surface *H*, Fig. 3, is turned by two tools *h*, Fig. 4, while the rear slide is fed longitudinally toward the left, and hole *I*, Fig. 3, is bored by tool *i* of a piloted boring-bar, while the middle slide is fed in the same direction. Simultaneously, the front slide is fed toward the center of the machine, causing tool *j* to rough-face hub *J*; tools *k*, *l*, and *m* to face surface *M*; and tool *n* to face surface *N*. The block that contains tools *k*, *l*, and *m* is given a slight longitudinal movement to bring the tools in line with their respective surfaces, by means of a roller and cam slot such as are used in the first operation. Tools *h* are arranged above each other, as may be seen in Fig. 2.

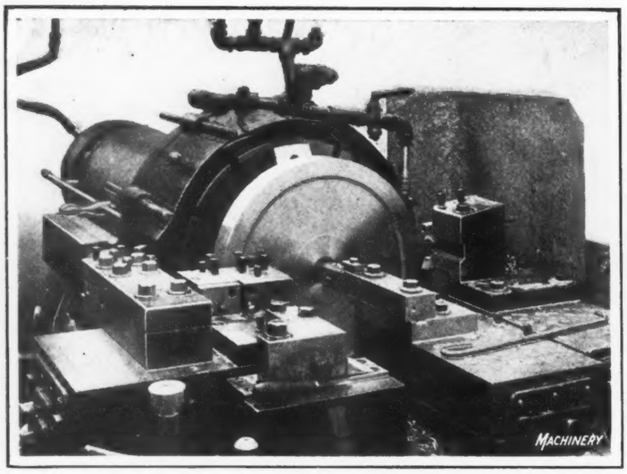


Fig. 7. Taking Finish-turning, Facing, and Boring Cuts on the Closed Side and Periphery of the Flywheel

The "Simplimatic" used for the third operation is provided with the tooling illustrated in Figs. 5 and 7, which is quite similar to that employed for the preceding operation. Surface *H*, Fig. 3, is finish-turned as the rear tool-slide feeds two tools *h*, Fig. 5, toward the headstock of the machine, and hole *I*, Fig. 3, is bored by tool *i*, Fig. 5, and chamfered by tool *j*, as the middle slide feeds the piloted boring-bar toward the left. At the same time, surface *M* is finish-faced by tools *l* and *m*; surface *N* is finish-faced by tool *n*; and the two outer corners of the flywheel are rounded by tools *o*, as the front slide is fed toward the center of the machine. The block that contains tools *l* and *m* is fed sidewise to bring the tools in line with surface *M*, by means of a roller and cam slot arrangement, as in the other two machines. Surface *M* is machined by two tools in the second and third operations, in order to reduce the time, the same as surface *D* is in the first operation. The engine lathe used for the fourth operation may be seen in the center of the heading illustration.

* * *

GENERAL MOTORS ENGINEERING SCHOOL

The General Motors Corporation is establishing its own technical school at Flint, Mich., where young men will be given specialized training to fit them for the automotive industry. The new school is to be known as the General Motors Institute of Technology. It occupies a ten-acre campus, and will provide educational facilities for 2000 students in day and night classes.

It is stated that the course will be similar in many respects to that offered by the University of Cincinnati in that the students will alternately attend classes and work in the shops. Four weeks will be given to studies in the full-time course, and then four weeks will be spent in the shops. This will make it possible for the students to pay the expenses incident to their education and at the same time obtain practical experience. The cooperative engineering course will be a regular four-year college course, and will be open to high-school graduates or boys of equivalent education. There will also be technical trade courses for boys from sixteen to eighteen years of age, intended to train them to become first-class mechanics and eventually foremen and shop executives.

* * *

The New Zealand Government railways are constructing several rolling-stock building plants. Four shops are planned, and while it is expected that a great deal of the equipment will be obtained in Great Britain, it is likely that some American machine tools especially suitable for railway shops will find a market in New Zealand. The plans involve an expenditure of over $7,000,000.

FORD THREE-ENGINE PLANES

Readers of MACHINERY who were interested in the article "Progress in Air Transportation," by William B. Stout, president of the Stout Metal Airplane Co., Division of Ford Motor Co., Dearborn, Mich., published in September MACHINERY, will be interested in learning that at the present time the company is building only three-engine planes at its new factory. These are built to specifications considerably different from those referred to in September MACHINERY. The new model Stout metal airplane built by the Ford Motor Co. is known as the model 4-AT tri-motored transport, and is built to the following specifications:

Span		68 feet 10 inches
Length		49 feet
Area of wings		740 square feet
Height		12 feet 8 inches
Wheel tread		15 feet 4 inches
High speed		110 miles per hour
Cruising speed		100 miles per hour
Stalling speed		59 miles per hour
Radius of action (cruising)		500 miles (5 hours)
Weight, empty		5200 pounds
Useful load		4000 pounds
Total weight, loaded		9200 pounds
Gasoline capacity		230 gallons
Wing load per square foot		12.45 pounds
Power load, per horsepower	two engines 23 pounds	three engines 15.3 pounds
Cabin Capacity	Width	4 feet 6 inches
	Height	5 feet
	Length	15 feet
Passenger accommodation (for twelve passengers with baggage)		335 cubic feet

* * *

CENTERING LARGE ROUGH FORGINGS

By CHARLES KUGLER

The centering of a large rough-forged shaft so that no rough spots will be left after the roughing and finishing cuts are taken is a job that sometimes taxes the resourcefulness of the lathe operator. A method of locating the centers on work of this kind, which the writer has used successfully in one of the largest machine tool shops in Philadelphia, Pa., is shown in the accompanying diagram.

The method consists of placing cold-rolled steel cross-pieces *C* at each end of the forging and joining the opposite projecting ends by tightly drawn wires *E*. The wires must all be located the same distance from the centers of the cross-pieces. If the forging is to be turned to a diameter of 20 inches, for instance, the dimension *B* should be 22 inches.

The positions of the cross-pieces are changed until the distance *A* at any point, as measured with a scale, is less than 1 inch. When the cross-pieces have been thus positioned, a center-punch that is a sliding fit in the holes *R* and *S* is used to center-punch the work at each end. The workman may be reasonably sure that a piece centered in this way will "clean up" when turned to a diameter of 20 inches. When the forging is exceptionally rough, however, it may be necessary to turn the cross-pieces about one-eighth of a revolution after properly locating them in one position, and check up the measurements in the new position.

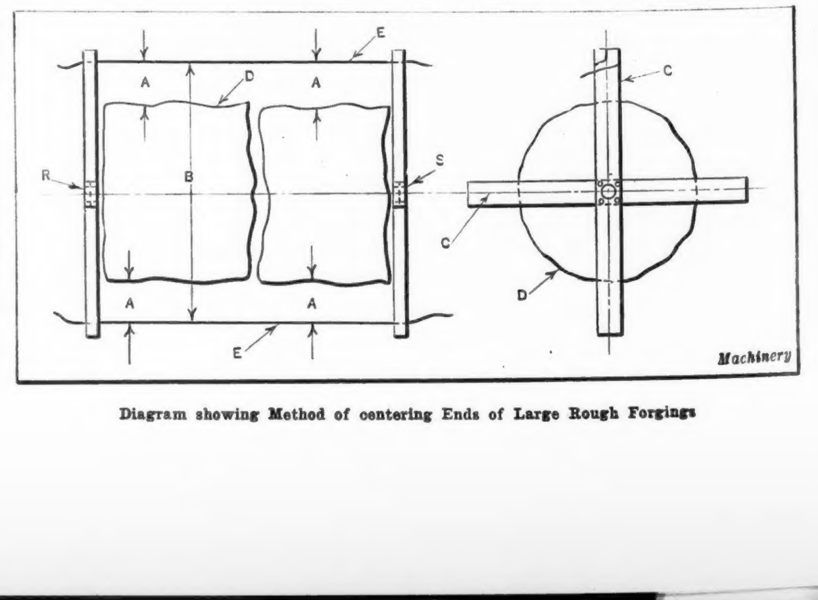


Diagram showing Method of centering Ends of Large Rough Forgings

Automotive Engineers' Production Meeting

In conjunction with the eighth annual convention of the American Society for Steel Treating and the National Steel and Machine Tool Exposition held in Chicago during the week beginning September 20, the Society of Automotive Engineers held its annual production meeting at the Hotel Sherman, Chicago, Tuesday, Wednesday, and Thursday, September 21, 22, and 23. Arrangements were made for four different sessions dealing, respectively, with conveyors, gear production, inspection, and machine tools.

Eight Papers of Value to Men Engaged in Quantity Production Were Read

Paul Phelps and N. H. Preble of Mechanical Handling Systems, Inc., read a paper on "Transportation by Conveyor," and Clarence A. Brock of the Miller-Hurst Corporation, read a paper on "Conveyors Used in the Automotive Industries." As conveyors are essential elements in quantity production, the subject was one of vital interest at the meeting. The two papers both dealt with the application of conveyors as purely transportation agencies and with the economic considerations that affect their installation. Individual conveyor types applicable to specific needs in automotive plants were described and illustrated.

At the gear production session, Walter G. Hildorf and John Bethune of the Reo Motor Car Co., read a paper on "Gear Steels and the Production of Automobile Gears," and Charles L. Cameron of Gould & Eberhardt read a paper on "Automobile Gear Production." Questions of the selection of the right kind of material, the right methods, and the best means for inspection, were dealt with at this session.

The general subject of inspection was discussed in a paper entitled, "Inspection Along the Line," by A. H. Frauenthal of the Chandler Motor Car Co. Mr. Frauenthal's paper discussed methods of increasing the output per inspection man-hour by time-studying inspection operations and, where possible, putting inspection operations in the production line. In addition, there was a symposium on special devices for automobile inspection, to which a great number of automotive engineers contributed. Papers were contributed to the symposium by A. R. Fors, Continental Motors Corporation; P. W. Rhame, A. C. Spark Plug Co.; J. B. Scott, Yellow Sleeve Valve Engine Works; C. S. Stark, Packard Motor Car Co.; and R. R. Todd, Oakland Motor Car Co.

Two papers were read at the machine tool session; one, by O. C. Kavle of the Manufacturers' Consulting Engineers, dealt with "Fitting the Machine Tool to the Job," and the other, by E. R. Stoddard of the Studebaker Corporation, answered the question "What Goes Wrong with Machine Tools in Automobile Production?" Factory visits were arranged to the Nash Motors Co., Kenosha, Wis., the International Harvester Co., and the Yellow Truck & Coach Mfg. Co., in Chicago.

The Production of Automobile Gears

In the paper on "Gear Steels and the Production of Automobile Gears," the authors gave an outline of the practice of the Reo Motor Car Co. in making gears, and also listed the kinds of steel used for gears and the heat-treatment employed. Reference was made to experiments that have been conducted in the Reo plant with gears, and the results obtained from research work were referred to, together with suggestions as to the lines along which research work should be carried on in the future. The methods and processes by which rear axle gears are machined, chamfered, tested, burnished, and lapped after hardening were described in detail. A somewhat less complete description was given of the methods used in making transmission gears; suggestions were also made for improvements in gears and axles.

Selection of Gear Steels

Referring to the selection of gear steels, the authors stated that it is very difficult to specify one particular steel that would be best for all conditions, because there are so many variable factors—loads, ratios, pitches, regular or stub teeth—that affect the selection of the material. Furthermore, the selection is influenced by the use of the gear, whether in a passenger car, truck, or bus. The following oil hardening steels were recommended: S. A. E. 3250, S. A. E. 5150, and S. A. E. 6150. The carburizing steels S. A. E. 2315 and S. A. E. 2512 were recommended; the former steel was especially recommended for ring gears and pinions.

Referring to the subject of forging, the authors stated that the gear blanks should be heated slowly, in order to provide uniform heat throughout the cross-section. Whenever possible, the forgings should be upset in order to obtain uniform strength in the teeth and eliminate warpage.

On the subject of electric furnaces as compared with cyanide or salt bath furnaces, the authors stated that in their opinion cyanide treated gears wear better, but they are somewhat noisier and have a different sound from those treated in the electric furnace.

Overcoming Warpage in the Heat-treatment of Gears

The authors outlined some of the more important precautions that may be taken in an attempt to overcome excessive warpage. Whenever the shape of the gear permits, as previously mentioned, the forging should be upset. The preliminary heat-treatment that will permit the gears to pass through the final treatment with the minimum amount of warpage does not produce a gear blank that is easily machined, but this disadvantage must be expected if warpage is to be avoided. Furthermore, the final heat-treatment must be very carefully handled and particular care taken not to exceed the maximum temperature, nor accelerate the rate of heating.

The quenching medium and the methods of quenching are also important. If two gears are heated in the same way and then one is quenched in water and the other in oil, they will not be of the same size and one will warp more than the other. Likewise, different methods of quenching in the same quenching medium will produce gears with different degrees of warpage. The quality of the steel itself also has an effect upon warpage, and must be closely watched by making fracture tests.

* * *

TURRET LATHE CUTTING SPEEDS

According to a table published by Alfred Herbert Ltd., Coventry, England, the following speeds, in feet per minute, are suitable for rough-turning the different materials specified in a turret lathe or automatic: Mild steel bars, 150; 3 per cent casehardening nickel-steel bars, 90; mild steel drop-forgings, 100; 3 per cent casehardening nickel-steel drop-forgings, 60; tool-steel forgings and bars, 45; cast iron, 50; steel castings, 50; gun-metal, according to composition, from 120 to 250; phosphor-bronze, 120; copper, 250; brass, 350; aluminum, 500. For finishing cuts the following speeds are given: Mild steel drop-forgings, 130; 3 per cent casehardening nickel-steel drop-forgings, 80; tool-steel forgings and bars, 55; cast iron, 70; steel castings, 70; gun metal, according to composition, 120 to 250; copper, 250; brass, 500; and aluminum, 500. No finishing speeds are given for mild steel bars and 3 per cent casehardening nickel-steel bar stock, because bar work from these materials is generally finished in one cut on turret lathes and automatics.

Current Editorial Comment

in the Machine-building and Kindred Industries

AUTOMOBILES AND MACHINE TOOLS

What is the secret of the remarkable values offered the buyer of automobiles and motor trucks today? In every other field, prices have materially advanced, as compared with ten years ago, but cars and trucks are not only cheaper today, but of higher quality. What magic wand has made this possible in the face of increased prices in every other direction? The answer is to be found in simplified design, improved methods of manufacture, high-production machinery, and a sufficient output to take advantage of this highly developed equipment.

The cornerstone of this entire price structure is the courage and confidence of automobile manufacturers in purchasing new and improved equipment. Machine tool builders, in cooperation with engineers and production experts in the automotive industry, have developed highly efficient equipment that will produce superior products at lower costs. Through this cooperation, results have been achieved that would not have been dreamed of fifteen years ago.

The leading article in this number of MACHINERY "Increasing Production with New Equipment" illustrates and describes what one company has accomplished by investing, during the past eighteen months, millions of dollars in new equipment to improve quality and reduce costs. The methods adopted and the machines installed represent the acme of present-day practice. Comparisons are made between present production figures and the rates obtained with the machines that were replaced. These figures will be of interest to everyone engaged in the automotive field and to machine tool manufacturers as well.

This policy of replacing old machines with the latest high-productive equipment has continued for years in scores of plants—more effectively, perhaps, in some than in others; but highly creditable to the management of all. The results are a credit also to the machine tool designers and builders, whose ingenuity and enterprise have made the new machines possible.

* * *

THE APPRENTICE QUESTION AGAIN

One of the objections raised by manufacturers to the training of apprentices is: It doesn't pay. Often when apprentices have been fully trained—sometimes before—it is said, they leave the plants where time and effort have been spent to make them good mechanics, and their training benefits other shops instead of those where they learned their trade.

The experience at different plants doubtless varies; but that of several large manufacturing concerns, as well as railroads, where apprentices have been systematically trained for many years, does not support this opinion. One well-known machine tool builder who has maintained a carefully organized apprentice system for some sixty years, and another who has had over forty years of similar experience, state very decidedly that it pays to train apprentices. Their experience is that a large proportion of the apprentices they trained have remained in their employ, and they consider a well organized apprentice system of great importance in the development and maintenance of a thoroughly trained manufacturing organization. Their apprentices receive a training that fits them for higher positions in the plants, provided they have in them the natural ability that warrants advancement.

In both of the plants mentioned many important positions are now held by former apprentices, and in one, practically all the important mechanical positions have been recruited from young men trained in the shop; the works engineer, superintendent, assistant superintendent, production engineer, chief draftsman, employment manager, as well as many foremen, inspectors and demonstrators, not to mention many toolmakers and machinists now employed by the company, are former apprentices.

The executives of both the companies mentioned believe that their organizations are strengthened by the apprentice system. The productive capacity of the apprentice is satisfactory because of their systematic training and instruction, and they compare favorably with the average shop man on similar classes of work. During periods of labor shortage, when the percentage of labor turnover is unusually high, the apprentices, who generally stay on their jobs until their course is completed, are an important factor in maintaining an organization.

The experience of one of the large electrical companies indicates that at least 40 per cent of its apprentices eventually are promoted to executive positions in the company's plants, and one of the largest of the western railroads that has developed an unusually well-managed apprentice system, estimates that about 90 per cent of the apprentices remain with the company. Reliable figures like these indicate that carefully organized and maintained apprentice systems not only can be made to pay, but to pay well.

* * *

NEW METAL CLEANING METHODS

Within a few years metal cleaning, instead of being looked upon as a very simple shop process to which little attention need be given by the management, has come to rank in importance with machining methods. Not long ago the only means employed in the shop for cleaning oil, grease and dirt from metal parts was to dip them in a kettle or barrel containing a solution of soda heated by a steam coil. In some cases this simple method served the purpose, but in many others it did not properly clean the metal, because, while this solution is effective for certain oils and greases, it will not dissolve and remove every kind of oil film. The oils found on machine parts in metal-working shops are usually of two kinds; one is a "straight" mineral oil and the other a mixture of mineral oil and so-called sulphonated or cutting oil. Straight mineral oils are by far the most difficult to remove, and special cleaning compounds are required so that the metal parts can be inspected, heat-treated, assembled or plated.

Thorough cleaning is especially necessary preparatory to plating, because only a chemically clean surface will permit a perfect metal-to-metal contact of the plating material and the metal to be covered. Acids and other corrosive materials that may adhere to the parts from previous operations must also be removed, and the cleaning compound itself must be free from any chemicals that would have a corrosive effect on the metal.

It is only recently that the necessity for effective metal cleaning has been fully recognized. As a result, several companies are now devoting themselves to the manufacture of cleaning compounds for different purposes, and at least one of them has developed an extensive service organization, the members of which are within easy reach of almost any shop in the country and qualified to give advice on cleaning metal parts effectively and economically.

No longer is metal cleaning a job for one of the lowest-paid laborers in the shop. They may still perform the actual work of dipping the parts in the tank, but the components of the solution are determined by men with expert knowledge in the chemistry of oils and cleaning compounds.

REMUNERATION FOR CONSULTING ENGINEERING SERVICE

By CONSULTANT

When a person is ill and goes to consult a physician, he expects to pay a fee for consultation, even when the prescription for his illness gives no relief. When a lawyer is consulted, a retainer is always in order. For all kinds of professional service there is a charge, varying in amount with the advice given.

Consider, as a contrast, the mechanical consulting engineer, with an office in New York City. If he is worthy of the name, he must be not much under forty years of age, with at least twenty years of practical experience behind him—otherwise, his consulting experience might not be of great value. If a manufacturer comes to his office seeking advice, he can sit down and talk over his problem with the engineer, and possibly even obtain a solution of it, without paying a cent. I have known plenty of cases where the greater part of a day would be spent in going over some problem, without any hint on the part of the customer that he was taking up valuable time and getting important information. In very few cases, is the engineer paid for this kind of work; it is considered as "all in the game," and the customer himself would in all probability feel offended if asked for a $25 fee for the day's work. Yet this would be a very moderate charge for a day's work in any other kind of professional consulting work.

Why Do Men in the Mechanical Industries Expect Advice for Nothing?

A man from South Carolina came to New York to ask my advice regarding the building of a model for a mechanical motor for which he had obtained a patent. I spent all the morning with him and took him out to lunch also, while looking over his patent papers and drawings. I had had a suspicion several times that his idea was faulty, until finally, after pinning him down to basic principles, I discovered that what he really had was a perpetual motion machine which he had in some way or other got through the patent office as a "mechanical motor." I advised him as gently as possible that it would be a waste of money to build a model of the device, for it could not possibly be successful. At four o'clock he collected his papers, and I took courage to advise him that I would make a charge of $25 for my day's work. He asked for a bill and said he would send me a check when he got home; but I never heard from him again. I saved him at least $1000 which he would have spent on a worthless model.

A few months ago I had an inquiry from England in regard to the cost of designing a special machine for a wire job, quite similar to one that I had built for an American firm. Details of wire sizes, output required, etc., were all given in the letter, and I found that certain features of the original machine would have to be changed to adapt it to this work; so thinking to save the customer money, I wrote him, suggesting that I could send him a set of blueprints of the original machine, with a series of free-hand sketches showing the changes necessary to adapt it to his work. I said I would do this on receipt of his check for $150, but I never heard from him again. Yet he would have received blueprints of a design that originally cost $600 to produce.

Interest Lags when it Becomes Evident that Service is to be Paid for

Another case in point is that of a firm in Georgia who wrote a five-page letter and sent floor plans of the shop, together with names and location of machines, and blueprints of a new product which they intended to manufacture, and asked for suggestions for the rearrangement of the machines to handle the work most expeditiously. After studying their problem, I wrote them stating that this would require a new plant lay-out and routing sheets for the work. They answered the letter asking what the cost would be for making up routing sheets and new plant lay-out and I said the charge would be from $200 to $250. After about three weeks another letter came requesting the return of the drawings, but saying nothing about the time already spent on their work.

It appears to the writer, after ten years experience as consulting engineer in New York City, that the average firm or individual seeking consulting engineering service, expects to get it for nothing; for the moment any suggestion as to payment is made, enthusiasm dwindles, and with one excuse or another, the customer does not go any further with the matter.

I have often wondered what the result would be if I were to advertise either on letterheads or leaflets that the charge for consulting service is $5 per hour or $25 per day, depending on the length of the job. It would be interesting to know how this would affect prospective customers, for I cannot understand just why they should expect to get free consulting service from a man who has spent his lifetime in gaining his experience, when they would not think of asking a physician or a lawyer to give them advice gratis. No doubt there are many other engineers who have had the same experience that I have had.

Promoters Use the Consulting Engineer as an Easy Mark

There was one extreme case where a number of blueprints were sent in to the office by a New Jersey firm, requesting a price for a complete set of operation sheets for manufacturing a new product in lots of 5000 a week, rough suggestions as to tooling and gaging, and the number of machines of various types that would be required. They were in a great hurry for the work, and wanted to know what the charge would be to get the data in shape. I called them on the telephone, asked a number of questions regarding the work, told them the charges, and they requested me to go ahead with the work. In the meantime, I sent them a confirmation letter regarding prices. I put six men to work at once; five days later a letter came in asking me to hold up on the work, as they had decided not to go ahead with it. I sent back the work at their request, together with the routing sheets and a number of cards showing the types of machines required, together with a bill for $600 for services rendered. I never received a cent for these services, not even an acknowledgement; but after putting the case in a lawyer's hands, he found out that it was a very small concern with no money, that was figuring on a new job which did not materialize. They conveniently sold out their small shop and vanished.

There are Some Who are Willing to Pay for the Service Rendered

Perhaps the whole question comes back to the difference in customers, for I can mention some cases just the opposite of those that have been noted. For example, shortly after the war a man I did not know called me up one day when I was extremely busy and said he wanted some advice about equipping a small factory for a certain line of work with which I happened to be familiar. I told him I could not possibly spare the time that day. He said that he wouldn't keep me over an hour or so and that he could get it all over during luncheon if I would take it with him, which I did. I answered his questions regarding equipment while he wrote it down. It used up about an hour and a half, and I said nothing about payment, but the next morning's mail brought me a pleasant note of appreciation attached to which was a check for $50.

A few cases of this kind tend to revive one's faith in human nature, but they are the exception rather than the rule. I believe that if firms desiring consulting service would treat the consultant as they would any other professional man, they would receive full value for their money, and encouragement would be given to a class of men who are seldom good business men, but who devote their entire lives to mechanical service chiefly because they love that work.

* * *

If all the punch presses in the stamping shop of one of the large electric companies were run continuously for one hour, one million stampings would be produced.

New Cincinnati Bickford Radial Drill

A NEW radial drilling machine which is being announced to the trade as the "Super Service," has just been brought out by the Cincinnati Bickford Tool Co., Cincinnati. Ohio, in 5- and 6-foot sizes. This machine is the result of more than five years of experimental research and development work. It has been designed around two major ideas--that it shall do more work in a given time than previous machines of this type; and that it shall have a longer life and a lower depreciation. To realize how these objects have been attained, it is first necessary to analyze the operation of a radial drilling machine. The hole-to-hole cycle consists of two parts: (1) The cutting time, or the time interval during which chips come out of a hole; and (2) the handling time, or the time intervening from the instant that chips cease to come out of one hole until they start to come out of the next hole.

In order to permit working high-speed steel cutting tools nearer to the limit of their capacity for any given job, it is necessary to provide a closer gradation of speeds and feeds than formerly. To meet this requirement, the new radial drilling machine is provided with thirty-six spindle speeds and eighteen feeds. This feature alone effects a decided saving in cutting time. The greatest saving, however, lies in the reduction of handling time. A radial drilling machine earns only when chips are coming out of the work. The handling time is absolutely non-productive, yet on average work, the handling time actually exceeds the cutting time. Observation over a wide range of operations frequently shows the handling time to be as high as 90 per cent of the total time, while the actual cutting time is only 10 per cent. For this reason, the new machine has been so designed that each movement of the operator is performed through the shortest possible distance with the least effort.

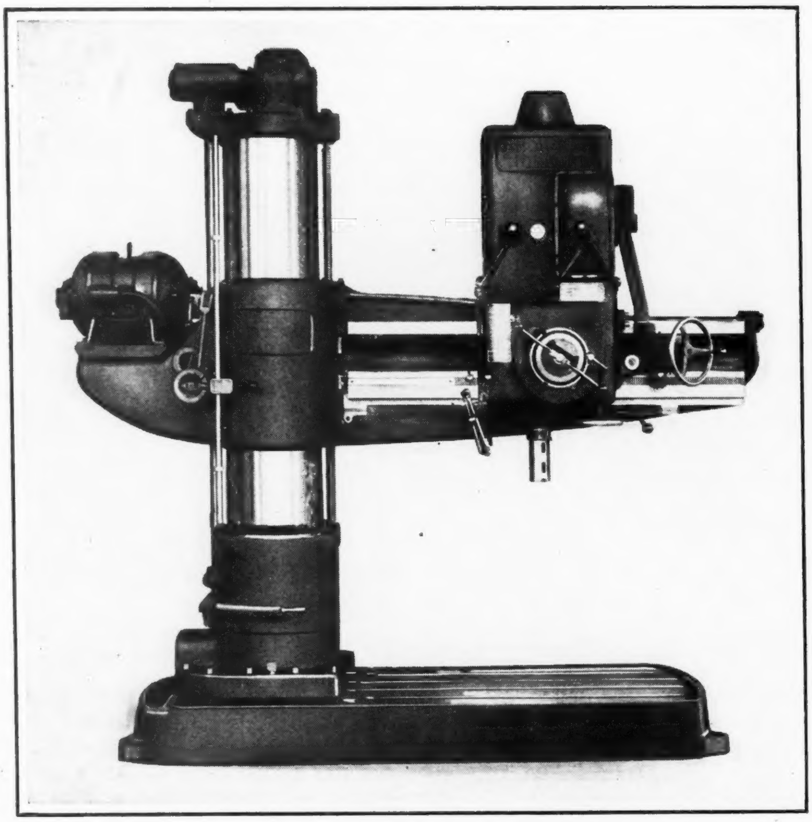


Fig. 1. Cincinnati Bickford "Super Service" Radial Drilling Machine

Centralization of control has been developed to an unusually high degree. The thirty-six speed changes are obtained through a mechanism that is entirely contained in the head. The head is equipped with a power rapid traverse. The pressure of one finger is sufficient to swing the arm, and a single lever is employed to clamp, unclamp, raise, and lower the arm. Power clamping of the column is controlled at the head. These features, together with properly located control levers, make faster handling of the machine possible.

Construction Details that Insure Long Life and Low Depreciation

Long life and low depreciation have had their share of attention in the development of this machine. A radial drilling machine is essentially a high-speed machine, with more shafts and bearings than most machine tools, and yet few machines in the shop receive as little care and attention, particularly in the matter of lubrication. As a result, repair bills for this type of machine are often high and depreciation rapid. This new radial drilling machine is so designed that it will operate over long periods without the necessity of oiling. The entire head is automatically oiled by a submerged pump, which forces oil through a "Purolator" filter to the top of the head. From this point, the oil cascades down through all gears and bearings. The friction clutches run in oil, and a high-pressure grease system lubricates the roller bearing spindle. A large reservoir supplies oil to the gibs and all surfaces of the head that bear on the arm. The arm raising and lowering unit and the motor driving gears run in oil, while the outer arm shaft bearing is packed in grease.

The entire driving mechanism from the motor to the spindle nose revolves in tapered roller bearings, all of which are sealed against the entrance of dirt. All shafts are multiple-splined, with integral keys. Driving gears and feed change-gears are made of heat-treated alloy steels. All speed and feed changes are made through sliding gears, tumbler gears having been completely eliminated.

The safety problem has also had careful consideration in the design of this machine. A patented safety nut is provided to sustain the arm in case the elevating nut should fail. Also, a positive mechanical interlock prevents raising or lowering of the arm while it is clamped to the column. The spindle counterbalance is located inside of the head, and a safety catch prevents the spindle from dropping if the counterbalance chain should break.

The frame of the machine is exceptionally rigid, the column diameter being 17 and 19 inches, respectively, for the 5- and 6-foot machines. The large column clamping area also adds to the strength of the machine. The flange by means of which the column is attached to the base is unusually wide and thick. The arm is of triple box section, and the side walls are made solid. The base is also of box section.

Details of the Head

The spindle speeds have a range of 60 to 1 with a maximum of 1415 revolutions per minute. Any one of five intake speeds may be furnished to provide the following minimum and maximum spindle speeds: 15 and 912, 16 and 1004, 18

and 1124, 21 and 1278, and 23 and 1415 revolutions per minute. As already mentioned, there are thirty-six speeds which may be obtained through the operation of three levers on the head. These changes are obtained with only seventeen gears, giving a noteworthy degree of simplicity to the speed mechanism. Eighteen closely graded feeds are obtained through the operation of only two levers. The feeds range from 0.006 to 0.125 inch per revolution of the spindle, and include leads for pipe taps of 8, 11 1/2, and 14 threads per inch. These tap leads relieve the operator of any exertion in starting pipe taps, and eliminate the possibility of thin threads being cut. A compensating depth gage not only insures drilling to a prescribed depth, but also compensates for the length of the drill point, enabling a hole to be drilled to its full diameter for a prescribed depth.

Even though the head is completely enclosed, includes a power rapid traverse mechanism, and contains the entire speed mechanism, it actually weighs less than the average radial drill heads of corresponding capacity. This result is secured through the use of aluminum for castings that are not subjected to strain. The power rapid traverse to the head is standard equipment. The constant-speed arm shaft is used as a source of power, which reduces the rapid traverse mechanism to a relatively simple device. The motor used on machines having arm shafts revolving at six or eight widely varying speeds has been eliminated. By means of a directional control, the head may be positioned quickly and without effort. The handwheel used in moving the head by hand does not revolve when the power rapid traverse mechanism is engaged.

Six splines on the spindle insure ease in overcoming the feeding resistance met with under heavy torsional loads. This is of great importance in heavy tapping operations, for it eliminates the danger of cutting thin threads. The spindle, spindle sleeve, and feed rack pinion are made of an alloy steel having an ultimate tensile strength of more than 200,000 pounds per square inch. This steel is said to have twice the hardness of ordinary spindle steels. The feed rack is integral with the spindle sleeve. The spindle is counterbalanced at all positions by a flat coil spring of unusual capacity. A patented cam arrangement compensates for the varying tension of the spring. The tension can be quickly adjusted to provide additional counterbalance for heavy cutter-heads, etc. As previously mentioned, a safety grip prevents the spindle from dropping should the counterbalance chain become broken. The entire counterbalance is enclosed in the head.

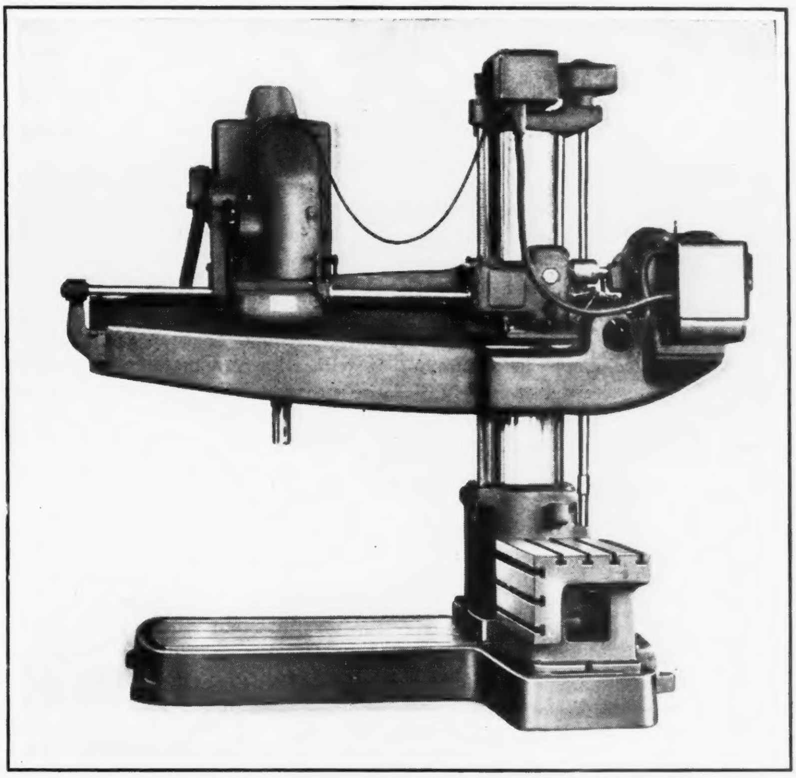


Fig. 2. View of Radial Drilling Machine showing Rear of Arm and Column

Construction of the Arm

The arm is massive and of a patented triple box section design which offers maximum resistance to bending and torsion. The front and rear walls are tied together with heavy longitudinal ribs, and the depth of the arm and length of the bearing on the column have been increased to a very great extent. A system of square lock gibs replaces the previous dovetail mounting of the head on the arm. The new design provides a high-grade bearing and maintains accurate alignment. It effectually prevents any rocking tendency of the head due to lack of adjustment of the main gib or to the cutting action of the tool.

A powerful equalized screw and lever action, applied to both ends of the split in the arm cylinder, binds the arm tightly to the column. Greater leverage is provided for closing the upper end on account of the increased resistance at that point. Safety stops prevent any movement of the arm beyond the upper and lower limits of travel.

The raising and lowering mechanism is built into the arm as a complete unit, fully enclosed and automatically oiled by a system of flood lubrication. The raising and lowering mechanism provided on the top of the column has been discarded, together with its clash gears. The elevating screw of the new machine is held stationary and the nut revolved. Friction clutches incorporated in this unit drive the nut in either direction without shock to any part of the mechanism. A safety nut prevents the arm from dropping, in the event that failure occurs in the threads of the main nut. It gives immediate warning of such a breakdown through failure of the elevating mechanism to operate, and the worn nut must be replaced before further raising or lowering of the arm is possible.

Design of the Column and Base

The unusual width and diameter of the column clamping surface cannot be overstressed, because maximum column strength is only possible when the column sleeve and trunk are effectively tied together as one rigid unit. The easy swinging of the arm is due to the distinctive construction of the lower part of the column. This construction consists of four large hardened steel rollers mounted on roller bearings. These rollers are built into the sleeve above the clamping surface and roll on a hardened and ground steel ring on the trunk. In no instance do rollers bear on cast iron.

An air or electrically operated mechanism is provided as standard equipment for clamping the column. Either mechanism enables the operator to clamp and unclamp the column without leaving the operating position at the head. This feature eliminates two round trips from the head to the column for every hole drilled. Air clamping is obtained through a double-acting air cylinder housed in the driving motor support, while electric clamping is obtained through a torque motor mounted on top of the column. Both the air cylinder and the motor are so located that they are not exposed to dirt and chips and are not in the way of the operator. There is no dangerous whipping action of the hand clamping lever, as this lever does not move when power clamping is employed.

The entire area of the base bears on the surface of the foundation. The top and bottom of the base are tied together by closely spaced, heavy longitudinal and transverse ribs. These ribs support the top uniformly, so that jack-screws or other supporting auxiliary devices are not required. The weight of the column, arm, head, and work, is transmitted

through the base ribs to the foundation. The box construction resists any bending tendency under heavy feed pressures.

Arrangement of the Motor and Electrical Connections

Only one motor is required to drive the spindle, elevate the arm, and operate the power rapid traverse. This motor is of the constant-speed type, and may be furnished for either direct or alternating current. Variable-speed motors are not necessary. The initial cost and maintenance expense of electrical equipment have been reduced to the lowest possible amount. The motor support is of deep section and cast integral with the arm. The machine is completely wired, the wiring being run from the motor to the top of the column, down through the inside, and out through the rear of the base, for connection with an outlet in the floor. Piping for the air type of column clamp is arranged in a similar manner. Both the wiring and piping are equipped with revolving connections in the lower part of the column to allow the arm to swing around a complete circle. This "Super Service" machine can also be furnished with a single pulley belt drive. The 5-foot machine weighs about 16,100 pounds, and the 6-foot machine, 22,000 pounds.

New Haven Machine Shop Practice Meeting

At the sixth annual machine tool exhibition held in New Haven, Conn., September 7 to 10, sixty-eight manufacturers of machine tools and shop equipment presented exhibits of great interest from the point of view of new developments. The exhibition was visited by a large number of mechanical executives from New England and nearby states. Most of the machine tools were shown in operation and engaged in production work. In addition to machine tools, machine shop accessories of various kinds, ball and roller bearings, heat-treating equipment, hoists, etc., were exhibited.

Technical sessions were held in connection with the exhibition at which papers of unusual interest were presented. General Ruggles, chief of manufacturing of the Ordnance Department of the United States Army, presented a paper on "Sane Specifications and Intelligent Inspection," in which he pointed out the necessity for developing specifications that are neither too rigid nor too indefinite, but that are based wholly upon the purpose for which the object is to be used. As an indication of how small changes in artillery munitions affects the range of guns, he showed charts indicating differences of thousands of feet in the range of guns when using shells with minute changes in dimensions.

Group Versus Individual Motor Drive

A paper on the group drive and the individually motorized drive was read by F. H. Penny of the industrial engineering department of the General Electric Co. This paper was briefly reviewed on page 58 of September MACHINERY. In discussing this paper, J. B. Armitage, chief mechanical engineer of the Kearney & Trecker Corporation, Milwaukee, Wis., stated that about four or five years ago, the sales of belt-driven and motor-driven milling machines of the larger sizes were about even. Today nine motor-driven machines are sold to one belt-driven machine of the No. 4 size. For the No. 3 size, the ratio is about 7 to 3 in favor of the motor drive; for the No. 2 size about 1 to 1; and only in the case of the No. 1 machine—the smallest built by the Kearney & Trecker Corporation—does the belt drive predominate. Here the ratio is probably approximately 6 to 4 in favor of the belt drive.

In the past, these machines were so constructed that the motor drive was an attachment furnished at an extra price. As the motor-driven machine now predominates, the machines have been redesigned to make the motor-driven machine the standard, and the belt drive is the attachment. At the present time, the price of a machine arranged for motor drive, but without a motor, is the same as that of a belt-driven machine without a countershaft, and it is quite conceivable that in the future, the belt-driven machine will cost more than the machine arranged for a motor. This remarkable increase in the use of individually motorized equipment has taken place in spite of the handicaps to the design imposed by the lack of standardized motor frames for this class of service.

Standardization of Machine Tool Motors Urged

"It has been suggested," said Mr. Armitage, "that manufacturers, meaning users, should adopt some one particular make of motor and insist that all tools coming into their plants be equipped with motors of that particular make. This suggestion is probably made from the motor manufacturer's viewpoint, but it is diametrically opposed to the machine tool builder's viewpoint, and should not be adopted wtihout first making a very thorough investigation. It imposes another hardship upon the machine tool manufacturer, who is striving to so design his product that after the application of the motor or motors and starting and controlling equipment, it will still appear as a well balanced whole and not as a collection of unassociated parts. What would it benefit a user to insist that the motors for a high-speed planer, a Blanchard type grinder, a punch press, and a cylindrical grinder requiring a flange-type motor be all of one make?

"The present trend in the machine tool industry is to have the motors either housed or built in as an integral part of the machine; the motor frame standardization is urgently needed so that a machine can be so designed that it will take any make of motor of a given horsepower, at the nearest speed to the required speed, and with any of the various current characteristics.

"Of equal importance is the standardization of the starting and controlling equipment. At the present time, very little provision can be made for this equipment, owing to the great diversity of space requirements of the various makes and systems. It would seem safe to say that if the electrical industry will properly standardize the dimensions of the motors and the starting and controlling equipment, the machine tool industry will be able to so design its product that the individually motorized machine will predominate to such an extent that the problem of group drive or individual drive will largely disappear."

The Artistic Side of Machine Design

A paper that aroused the keenest interest was presented by Dean Dexter S. Kimball of the College of Engineering, Cornell University, on "Decoration and Proportion in Machines." In this paper, Dean Kimball pointed out that there are three stages through which any machine or mechanism may pass. First is the stage where utility alone is considered—the crude stage where the object is made to perform its function irrespective of appearance. The second stage is the decorative stage, when all kinds of decorations, sometimes wholly foreign to the purpose of the machine or object being made, are introduced in the design. The third stage is one where the design has been consistently and carefully worked out to harmonize fully with the purpose of the machine or object. He referred to locomotives, automobiles, typewriters, and machine tools as having passed through the first two stages, and now being examples of the completed design in the third stage.

The district apprentice system was dealt with in a paper by Harold S. Falk, vice-president and works manager of the Falk Corporation, Milwaukee, Wis. This paper was published in full in September MACHINERY, page 20.

A paper entitled "Cold Finishing of Metals in Interchangeable Manufacture" was presented by E. V. Crane of the E. W. Bliss Co., Brooklyn, N. Y. An abstract of this paper will be found in this number of MACHINERY, page 118.

Report on Gear Tests

At one of the technical sessions a paper was presented on "The Influence of Elasticity and Errors in Tooth Shape on the Stresses in Gears." This paper is part of a thesis submitted by John Edward Nicholas to the Massachusetts Institute of Technology, Cambridge, Mass., for the degree of Master of Science. The work reported was done under the direction of Professor Earle Buckingham, a member of the A. S. M. E. special research committee on the strength of gear teeth. The paper had been arranged by Professor Buckingham as a progress report of the committee for presentation at the meeting mentioned.

Those who have followed the development of the work of this committee will recollect that Wilfred Lewis, at the request of the committee, of which he is the chairman, designed a gear testing machine that was built by the Bilgram Machine Works, Philadelphia, Pa. The machine was installed at the Massachusetts Institute of Technology, where the actual tests are being made under the direction of Professor E. F. Miller of the department of mechanical engineering. The purpose of the gear testing machine is primarily to make it possible to determine the effect of varying degrees of tooth accuracy and varying velocities on the strength of gear teeth. The report presented at the New Haven meeting is very comprehensive. It will be published in full in *Mechanical Engineering*, the journal of the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

One session was devoted to a symposium on "What's New in the Machine Tool Industry?" During this session four brief illustrated papers were presented, one dealing with tapered roller bearings, one with modern milling practice and milling fixtures, one with electric welding, and one with internal grinding machines.

Standardization of T-slots and Milling Cutters

In connection with the meeting, conferences were held on standardization. The T-slot committee met and decided upon a definite report to be submitted to the sponsor bodies, the American Society of Mechanical Engineers and the National Machine Tool Builders' Association. The standardization of milling cutters was launched by a conference that recommended to the sponsor bodies—the two associations mentioned and the Society of Automotive Engineers—that a committee be appointed for the purpose of standardizing milling cutters.

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SPRINGS FROM MONEL METAL

When springs are exposed to dampness or chemicals that cause them to rust and corrode, monel metal makes a satisfactory material. In the past, spring wire of this metal has not been available, but during the last two years, the W. D. Gibson Co., in cooperation with the International Nickel Co. and the Driver-Harris Co., has made a study of the possibilities of using monel metal for springs, and has developed methods for cold-drawing this metal, so that now a uniform and reliable grade of monel metal spring wire is available in sizes up to 1/2 inch in diameter. This metal has a torsional strength of 80,000 pounds per square inch, a torsional modulus of 9,250,000, a tensile strength of 135,000 pounds per square inch, and a tensional modulus of 25,000,000. The safe working stress in torsion for monel metal in cases where fatigue is not a factor is said to be 70,000 pounds per square inch. In cases where fatigue is a factor and it is desired that the spring shall operate 2,000,000 times without fracture, a safe working stress in torsion of only 30,000 pounds per square inch should be employed.

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Commercial aviation in Germany, in 1925, attained a volume four times as great as in 1924. There were fifty-six air lines in operation at the end of 1925, serving sixty-one German cities, and carrying 55,185 passengers. The German Government makes it a practice to subsidize commercial air lines.

NATIONAL MACHINE TOOL BUILDERS' EXPOSITION IN 1927

The National Machine Tool Builders' Association has announced that a machine tool exposition will be held in Cleveland, September 19 to 24, 1927. This exhibition will be under the direction of the association, and is to be the first of a series of annual expositions. It is to be open to displays not only by companies that are members of the association, but also by other companies or individuals who manufacture machine tools or machinery, equipment, supplies, accessories, and materials for, or who render services in connection with, the machine shop field. The object of the exposition is to centralize the exhibits of the machine tool industry.

In a prospectus issued by the association, it is pointed out that the machine tool industry requires an annual exposition of products for effective distribution. So far, there has been no uniform method whereby machine tool builders have been able to present their products to prospective users. As a result, machine tools have been displayed and demonstrated at various regularly or intermittently scheduled expositions. The object of the exhibit of the National Machine Tool Builders is not to add another exhibit to those already held, but rather to offer one exhibition at which all machine tools and all machine shop equipment may be shown. The association believes that there must be centralization and simplification of the exposition effort and expense of the machine tool manufacturers. In referring to this, the following statement is made:

"The primary purposes of the exposition are the elimination of the waste involved in the scattering of exposition energy and expense—the providing for 1927 and succeeding years of the industry's own agency geared to a clear-cut business purpose—the making more effective, while less dispersed and costly, the necessary annual visual presentation of machine tool progress and possibilities to machine tool buyers, actual and potential. It is to be a centralized, single-goaled, sound, and necessary medium for the industry's joint and necessary distributive effort."

It is also announced that there will be no visitors' entrance fee, admission to the exhibition being by registration only; in this way, the attendance will be limited to those who have a direct interest in machine tools and accessory equipment. On the other hand, any person who is interested may obtain admission without the payment of a fee, and will be presented with a badge identifying him by name and also giving the name of the company with which he is connected.

The plans for the exposition are in charge of a committee consisting of J. Wallace Carrel, vice-president, Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, who is the chairman; P. E. Bliss, vice-president, Warner & Swasey Co., Cleveland, Ohio; H. W. Dunbar, assistant general sales manager, Norton Co., Worcester, Mass.; O. B. Iles, president, International Machine Tool Co., Indianapolis, Ind., and E. J. Kearney, secretary, Kearney & Trecker Corporation, Milwaukee, Wis.

The association is now ready to make space allotments. Communications with regard to this should be addressed to the National Machine Tool Builders' Exposition Manager, Room 635, 1328 Broadway, New York City.

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TWENTY-FIFTH ANNIVERSARY OF THE UNITED STATES STEEL CORPORATION

The United States Steel Corporation is twenty-five years old. It was organized in 1901, through the consolidation of ten separate companies engaged in the manufacture of steel and in allied industries, each company prominent in its own particular field. In commemoration of the twenty-fifth anniversary, the Steel Corporation has issued an anniversary publication containing statistics and photographs of the different plants, showing the company's activities in various fields, industrial relations, and employe activities. An interesting graphical presentation is given of the decrease of accidents since 1906, due to the effective accident prevention work carried on in the various plants of the corporation.

Steel Treaters' Convention and Exposition

THE annual convention and exposition of the American Society for Steel Treating took place in Chicago September 20 to 24. The technical sessions of the convention were held at the Drake Hotel, while the exposition was on the Municipal Pier, where the exhibits covered an area of 80,000 square feet. There were considerably more than 300 exhibitors, of which over 100 exhibited machine tools, small tools, and machine shop accessories. The other exhibits consisted mainly of all classes of steel, and hardening room and heat-treating equipment. Practically every machine tool exhibited was shown under power, and actual production work was being performed. Many of the furnace installations were shown in operation and the visitor got the impression of an active and busy industrial plant.

In connection with the exhibit, the American Society for Steel Treating held its technical sessions each morning and afternoon. Close to forty papers, covering practically every phase of the metallurgy, heat-treatment, and testing of steel were presented. One of the features of the convention program was the E. D. Campbell Memorial Lecture which was delivered by Dr. W. M. Guertler of Berlin, Germany. Dr. Guertler is recognized as a leading exponent of advanced thought in both ferrous and non-ferrous metallurgy. The subject of Dr. Guertler's lecture was "The Corrosion Resistance of Steels." On another occasion during the convention he also spoke on "The Hardness of Metals."

Standardizing the Brinell Hardness Test—Machining Properties of Annealed Cast Iron

Out of the great mass of excellent papers presented, it is difficult to pick a few that may be of more than usual interest to MACHINERY's readers. The paper on "Standardizing the Brinell Hardness Test," by H. M. German of the Universal Steel Co., Bridgeville, Pa., contained matter of special interest to those engaged in the machine shop field. This paper pointed out defects in different types of testing machines and described a new design which, the author stated, would overcome the defects outlined and eliminate the personal factor of the operator, thereby providing for a definite standardization of the Brinell hardness test.

In a paper on "The Mechanical and Machining Properties of Annealed Cast Iron," the authors, G. C. Priester and F. J. Curran, recorded the results of their study of the machining and mechanical properties of a cast iron used in the manufacture of pistons, when subjected to various annealing temperatures. The machining properties of the annealed pistons were studied in a modern production plant. The results of the tests are summarized as follows: In heating a gray cast iron above the critical temperature and permitting it to cool slowly, the machineability is improved in the ratio of approximately 6 to 1; the maximum strength and hardness is decreased from 30 to 40 per cent; the modulus of elasticity is decreased from 8 to 10 per cent; the maximum deflection under transverse loads is only slightly decreased; the allowable working stresses are decreased about 10 per cent for the same deflection; and the microstructure is materially changed.

Honorary Membership Conferred upon Gary and Schwab

A special feature of the annual banquet of the society held Thursday evening, September 23, at the Drake Hotel, was the conferring of honorary membership upon Elbert H. Gary and Charles M. Schwab. A founder membership was presented to Arthur G. Henry, of Chicago, who was one of the organizers of the association and of the first National Steel and Machine Tool Exposition.

During the convention, numerous industrial plants in Chicago and the vicinity were visited by members of the American Society for Steel Treating and members of the Society of Automotive Engineers.

In conjunction with the convention, the Society of Automotive Engineers held a production meeting, and the Machine Shop Practice Division of the American Society of Mechanical Engineers held a session. The meeting of the automotive engineers is referred to on page 97 of this number of MACHINERY.

Meeting of the American Society of Mechanical Engineers

The American Society of Mechanical Engineers held its session in the afternoon of September 23. At this session four papers were read. "The Possibilities of Standardizing Design Details in Plants Manufacturing Special Machinery" was dealt with by Herbert K. Keever of the McDonald Machine Co., Chicago, Ill. The author pointed out that standardization of design detail is an important factor in the shop manufacturing special machinery and that it should not be applied to single parts only, but to unit assemblies as well. The advantages of such standardization result in lower cost of manufacture. The use of charts for standard units was discussed.

"Inspection Methods" was the subject of the paper read by E. D. Hall, superintendent of inspection development, Western Electric Co., Chicago, Ill. This paper treated of inspection work as a function of a manufacturing department. It pointed out the need for controlling the quality of the product; maintaining standards; reducing losses by early discovery of poor materials or workmanship; controlling piece-work payments; and furnishing reports to assist in executive control. Some of the subjects included were the development of equipment and methods that will enable inspectors of ordinary ability to make precise measurements and tests rapidly, with satisfactory results; the design and use of automatic gaging and testing apparatus; inspection work in connection with pace-setting equipment, such as belt conveyors; optical projection methods for inspecting contours and amplifying the measurements of small dimensions; the uses of photo-electric cells and vacuum tubes in the amplification of measurements; and the translation of visible indications into audible signals.

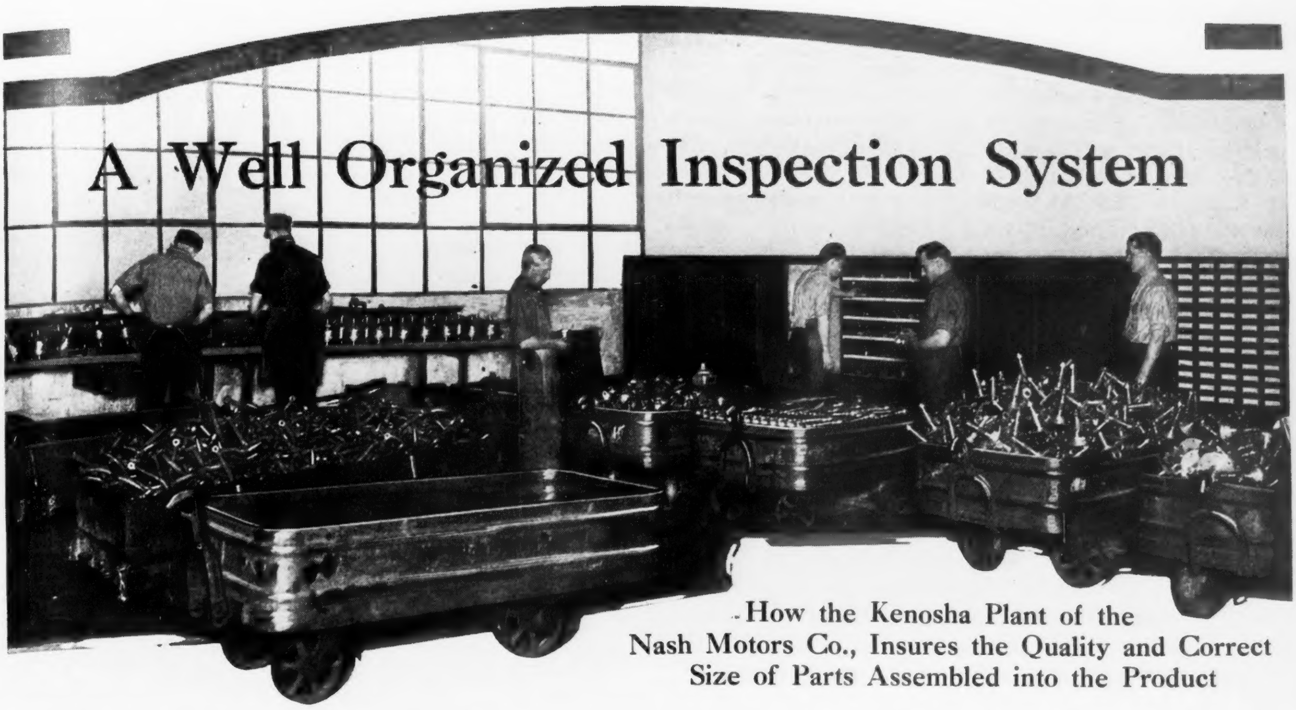
A paper on "Drop-forge Hammer Anvils" was read by Eugene C. Clark of the Chambersburg Engineering Co., Chambersburg, Pa. Mr. Clark pointed out that the anvil and its foundation necessarily affect the production and efficiency, as well as the life of the hammer and the surrounding buildings and equipment. The necessity of using a cushion between the deflected mass and the foundation, to absorb the deflection in the anvil and release the strains caused by the impact was dealt with. Inclusion of many calculations and charts makes the paper valuable to the man engaged in forging work.

A paper dealing with the importance of foremanship training in industrial plants, pointing out necessary qualifications for a good foreman, was read by Hugo Diemer, director of Industrial Development at the LaSalle Extension Institute, Chicago, Ill.

* * *

COLLEGE COURSE IN ACCIDENT PREVENTION

The importance that industrial safety work has assumed in the last twenty years is exemplified by the fact that in response to a demand from all parts of the country for trained leaders in safety work, New York University, with the cooperation of the American Museum of Safety, will offer, during the present college year, the first college course in accident prevention.



A Well Organized Inspection System

How the Kenosha Plant of the Nash Motors Co., Insures the Quality and Correct Size of Parts Assembled into the Product

THE primary object of an inspection department is to make certain that no over-size, under-size, or defective parts are assembled into the finished product. To attain this end in a large plant operating on a quantity-production basis, it is necessary to employ a considerable force of inspectors and an efficient system of controlling their work. In the Kenosha, Wis., shops of the Nash Motors Co., there are approximately 250 inspectors whose work is carried on successfully through the operation of an effective system, which will be described in detail here.

All the work of the inspection department is supervised from the office of the chief inspector, which is also occupied by the assistant chief inspector, a clerk, and a man whose duties consist of checking new gages delivered to the office or gages brought there by the inspectors in the shop. In each department of the shop, there is a foreman inspector who has under him groups of floor and final inspectors. These inspectors are responsible only to the foreman inspector and each foreman inspector, in turn, is responsible only to the chief inspector. With this arrangement any questions as to whether parts should be passed by inspectors, are settled entirely by the inspection department, and there is no dissension caused by divided authority.

Duties of Different Classes of Inspectors

Floor inspectors go from machine to machine and check work coming from both semi-finishing and finishing operations. This inspection is in addition to that performed by the machine operators, most of whom are also provided with gages. Another duty of the floor inspectors is to periodically inspect all gages used in the departments to which they are assigned and to keep a record of the dates when each gage was inspected. Floor inspectors are required to report immediately to the production foreman, if machines or tools are not functioning properly, so as to eliminate defective parts as far as possible. When parts have been produced by a machine or tool that is not functioning entirely as it should, these parts are set aside from the ordinary run of work, to be given an extra close checking in the final inspection before they are passed on to the next department.

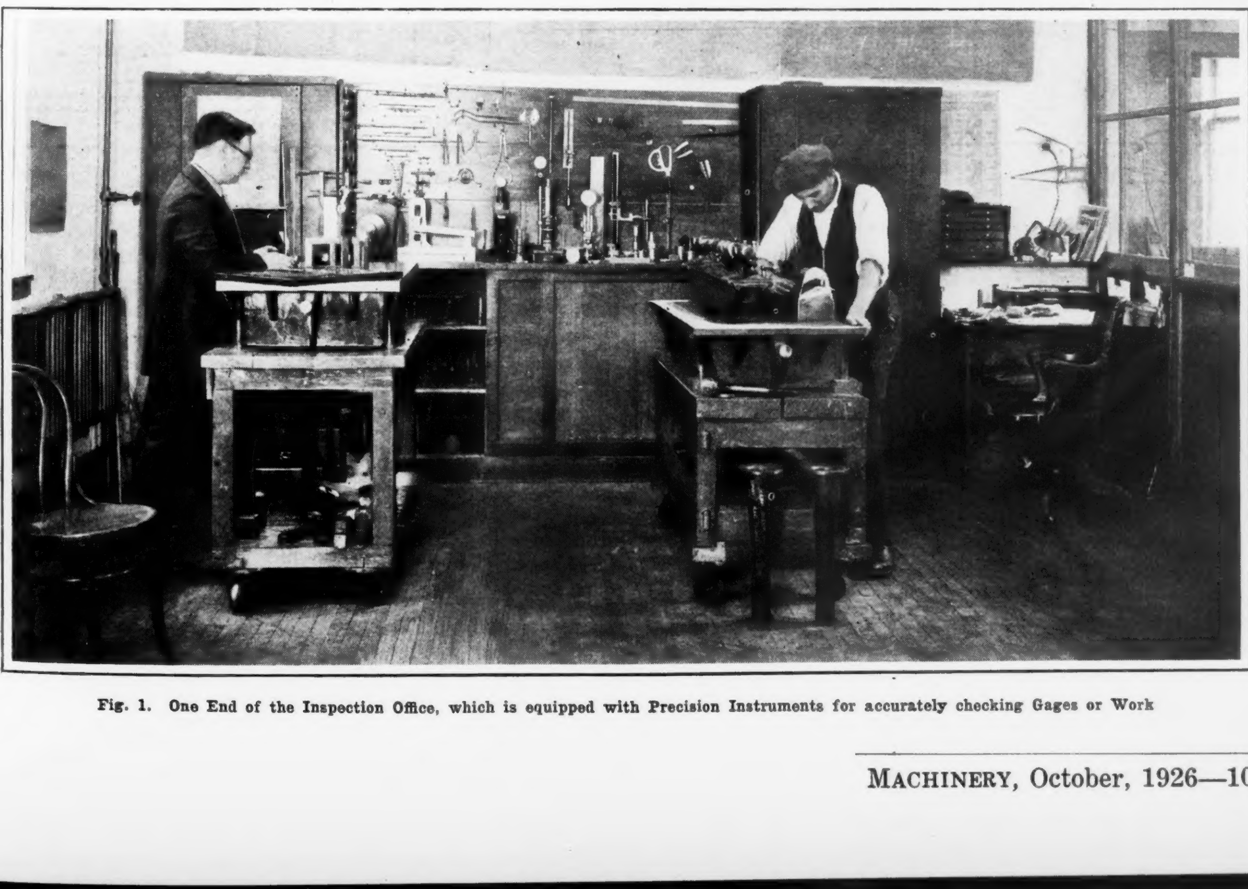


Fig. 1. One End of the Inspection Office, which is equipped with Precision Instruments for accurately checking Gages or Work

The final inspection in each department is performed either in a separate room, such as shown in the heading illustration, to which all parts are trucked, or else at separate benches adjacent to the machines on which the parts are finished. Before going to the final inspection, most parts are run through washing machines to cleanse them thoroughly from all dirt and chips. Sometimes every piece is checked in the final inspection, but in other instances, only one out of ten or so. This depends upon the nature of the part, the tolerances specified on the various surfaces, and the condition of the machines and tools used in finishing the part. Maximum effort is always directed toward 100 per cent inspection of parts held to the closest degree of accuracy.

All parts are counted by the final inspectors, and the total number of pieces transferred to the stock-room, assembling lines, or heat-treating, grinding, and similar departments must correspond to the production record of the department or the missing parts must be accounted for. Defective parts are returned for remachining to the department in which they were made, or scrapped if they cannot be remachined within specifications. Special parts are never ordered to suit over-size or under-size pieces, and there is no selection or fitting of parts in assembling. Each foreman inspector daily receives a "shortage" list from the production clerk of the department to which he is assigned, which serves as a notice to expedite inspection of certain parts. All parts that are purchased from outside sources are inspected at the time that they are received.

In some departments, it has been found advisable to have the final inspectors perform small operations on the parts, in addition to inspecting. One part to which this applies is the differential housing which is made in two halves that are bolted together for machining. Burrs are produced on the inside of the housing in machining which cannot be removed without taking the housing apart, and since the inspector must disassemble the two halves anyway in order to check certain dimensions, he is required to remove the burrs at the same time. All inspectors are paid by the hour, even though machine operators are paid on the piece-work basis. In some departments, the inspectors are girls, this being the case in the piston and the roller bearing departments.

As a check on the final inspectors, there is a man of much experience assigned to the assembling lines, who inspects various important parts from time to time. For instance, he rechecks valve seats of cylinder heads for concentricity with the valve stem holes, and certain gears for distortion. He also examines a number of engines after they have been put through a preliminary running test to determine the piston clearance and the fit of various bearings. This man is also "trouble shooter" for the inspection department, and is responsible directly to the chief inspector.

FIFTH COPY
WORKS ENGINEER'S COPY

F1408 2M 7-7-25 L.H

Date of Issue: 8-5-25

№ 9817

WORK ORDER AUTHORIZATION
NASH MOTORS CO.

Date of Authorization	Authorization No.
8-15-25	A-2745

Department For Which the Work is to be done		Estimated Cost	Actual Cost
NAME Insp. Dept. NO. 43		Material 8.00	Material 7.50
Repairs or Replacements	New Installation	Labor 80.00	Labor 74.00
	Additional Equipment	Total 88.00	Total 81.50

Requested By J. S. Coney — Div. Supt. or Foreman
Approved by J. Bjorn — General Supt.
Approved By P. Moohan — Works Manager

SPECIFICATIONS OF MATERIAL AND WORK TO BE DONE BY Tool-room WHEN 9-10-25

Four fixtures as per gage blue-print B-2486-3, to round up roller bearing cage and provide correct amount of clearance for rollers after assembly.

WORK ORDERS AND MATERIAL REQUISITIONS ISSUED

Date	Order No.	Dept. No.	DESCRIPTION	Date	Order No.	Dept. No.	DESCRIPTION

IF NEW EQUIPMENT STATE WHY NECESSARY AND WHAT OPERATING ECONOMIES WILL RESULT

To insure uniform clearance and to reduce labor charges. Will reduce labor 15%

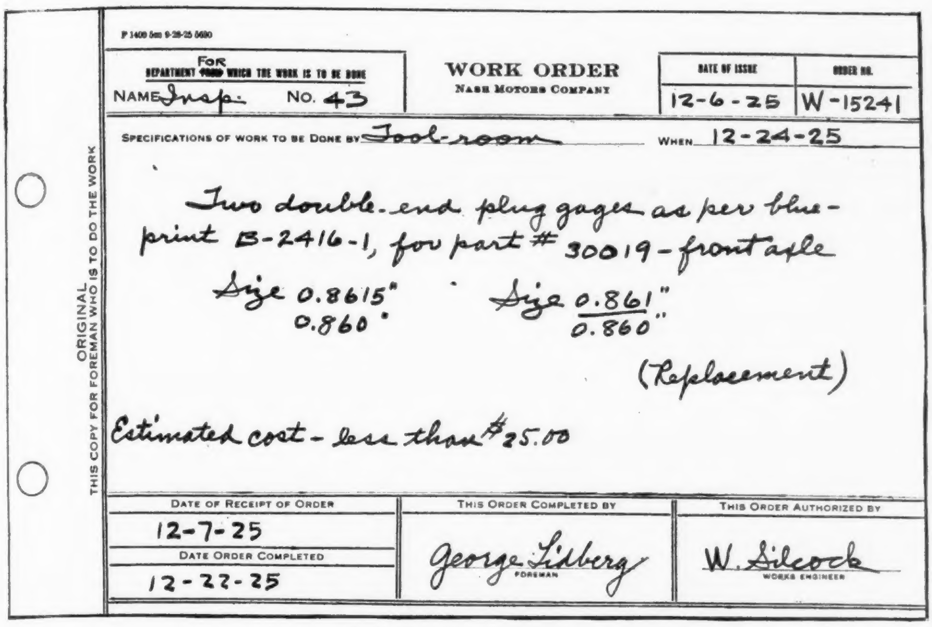
Prepared by Wm Silvoch — Works Engineer
Authorized by J. T. Wilson — Ass't Gen'l Mgr
Date Completed

THIS AUTHORIZATION MUST BE OBTAINED FOR ALL NEW EQUIPMENT AND REPAIRS COSTING MORE THAN $25.00 IN MATERIAL AND LABOR

Fig. 2. Form which gives the Authorization of Various Executives for making Gages costing over a Certain Amount

One man connected with the inspection department is assigned to the yard to see that all scrap is placed in bins according to the material. Not only are ferrous and non-ferrous metals separated, but the various kinds of steel are also sorted according to their analyses. This is done so that the foundry will know the exact character of scrap delivered to it.

The men who make final tests on the completed engines and automobiles do not come under the authority of the inspection department, but make daily reports to that department in relation to any difficulty about which the department should be informed. Reports are also made to the inspection office by the physical laboratory, relative to the hardness of iron used in the casting of cylinder blocks on the preceding day. As the date of casting is always marked on the cylinder blocks, this report gives information of considerable value.


P 1400 5m 9-28-25 0690

ORIGINAL
THIS COPY FOR FOREMAN WHO IS TO DO THE WORK

DEPARTMENT ~~FROM~~ FOR WHICH THE WORK IS TO BE DONE
NAME Insp. NO. 43

WORK ORDER
NASH MOTORS COMPANY

DATE OF ISSUE	ORDER NO.
12-6-25	W-15241

SPECIFICATIONS OF WORK TO BE DONE BY Tool-room WHEN 12-24-25

Two double-end plug gages as per blue-print B-2416-1, for part # 30019-front axle

Size 0.8615" / 0.860"   Size 0.861" / 0.860"

(Replacement)

Estimated cost - less than $25.00

DATE OF RECEIPT OF ORDER	THIS ORDER COMPLETED BY	THIS ORDER AUTHORIZED BY
12-7-25	George Lidberg (FOREMAN)	W. Silcock (WORKS ENGINEER)
DATE ORDER COMPLETED 12-22-25		

Fig. 3. Slip giving the Tool-room Authority to make Gages

Cooperation is always essential to the successful handling of a large group of men. In this inspection department, cooperation between the inspectors is maintained by the chief inspector keeping in close contact with his men, so as to thoroughly understand their inspection troubles and viewpoints. Each foreman inspector has a period allotted to him every morning between the hours of seven and nine when he is required to call at the inspection office for a personal interview with the chief inspector. To this interview the foreman inspector brings a written report of all inspection troubles experienced during the preceding day by the men under his supervision. These difficulties are discussed by the chief inspector and the foreman inspector, and means devised for overcoming them, if this has not already been accomplished.

Four typewritten copies of the foreman inspector's report are made by the clerk, one of which is sent to the works manager and one to the production foreman of the department concerned. The third copy is given to the foreman inspector, and the fourth is retained in the inspection office. The report sent to the production foreman serves as a warning to him to remedy conditions resulting in unacceptable work, while the report that the works manager receives notifies that executive concerning the matter. If an undesirable condition should remain unchanged, either through neglect or because it cannot be remedied at once, the fact is brought out daily in the foreman inspector's reports. Sometimes one foreman inspector gives information during the interview that may be advantageously passed on to the others, or makes suggestions as to improvements in gaging equipment, etc. The chief inspector, in turn, imparts to the foremen inspectors knowledge which has come to him from various sources.

In addition to these morning interviews, both the chief inspector and his assistant make daily visits to all the foremen inspectors in their departments. Notes are taken down of information to be passed on to other persons or to be discussed at the interviews on the following morning. This close connection between the chief inspector and his men keeps the chief inspector constantly advised of all matters that should be brought to his attention and has resulted in a well knit and efficient organization.

Either the chief or assistant chief inspector attends a meeting of the works manager and production managers that is held every afternoon. Through this contact with the manufacturing heads, the inspection department becomes advised of parts urgently required in any department, and can make arrangements to expedite the inspection and transfer of the parts to that department. At these meetings also, the inspection department representative is advised of changes contemplated in a piece of work which may affect the gages used for inspecting that part.

There is also a weekly meeting of all foremen, the chief inspector, etc., at which Mr. Nash, the president of the company, usually presides. Complaints from dealers, owners of cars, and other sources are discussed at this meeting, and corrections arranged for. Sometimes when a defective part has been found in service, the inspection department makes arrangements after this meeting for reinspecting all parts of that type in stock or in the shop.

Methods of Inspection

Whenever possible, the progressive method of inspection is carried out; that is, one man uses one gage for checking one or more surfaces, and then passes the work to a succeeding man, who also uses but one gage, and so on until the work reaches the end of the inspection bench. Inspection can be speeded up by this method, because a man becomes more proficient when handling a single gage than when using several.

Indicator gages are used, whenever possible, to reduce troubles in inspection resulting from the human element and also to facilitate inspection. Sometimes the space on an indicator dial between the graduations that represent the limits on the work, is covered with blue or red crayon. This helps the inspector to see if a part is within the specified tolerance, and saves eye fatigue. It is not necessary for him to know exactly how much a part varies from the nominal size, and by merely glancing at the dial, he can readily see if the needle has moved beyond the crayoned space.

Diamonds are often used for the contact points of dial indicator gages, and when these gaging devices are not so equipped, they are provided with stellite contact points. It is the practice to so design dial indicator gages that the

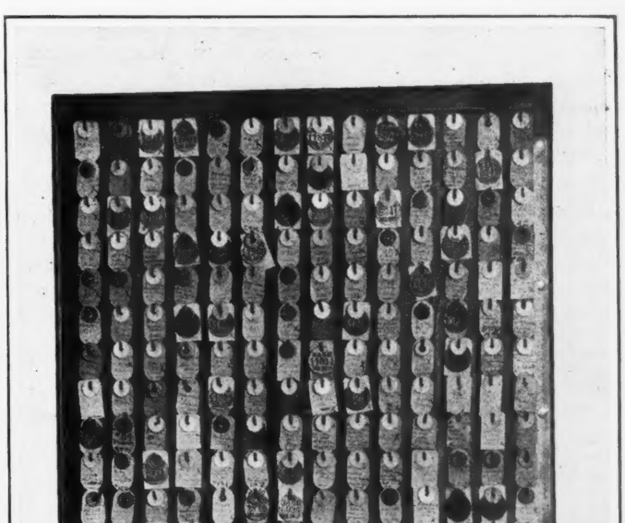


Fig. 4. Cabinet Door on which are hung the Tags of Instruments lent by the Inspection Office

pressure on the contact point is reduced rather than increased when work is placed in the gage. This method has materially increased the life of such equipment. All indicator gages are set by means of masters. Snap gages on which the limits are particularly close are checked by means of master disks ground to size. When these disks can be slipped between the jaws of the gage, the measuring surfaces have worn beyond the limits. The disks are always made the same width as the gage jaws. Plug gages are checked by means of amplifying gages.

Designing and Ordering Gages

Whenever a part of new or changed design is to be placed in production, a blueprint of the part and a slip containing all essential information are received in the inspection office. If the slip is blue, is denotes that the part is of new design, but a yellow slip indicates changes in an existing design. From the blueprint and the slip the inspection department determines what gages, if any, must be made or purchased

REQUISITION

To Tool Order Dept. Date 1-28-26

Required by: Dept. Insp. 14

Charged to: Dept. 43 Order No. Mach. No.

Quantity	DESCRIPTION	Price	Value
1	Indicator gage as per blue-print B-2741-3 to check alignment of bearings in differential carrier #54158		

Approved .... Foreman

Fig. 5. Form used in sending Requisitions to the Tool Design and Tool Order Departments

for the part. Before any gage is actually decided on, the tooling used for the job is investigated, because the method of machining the part often influences the design of the gages used for its inspection.

Drawings for new gages are ordered from the tool design department on a requisition slip which is made out in triplicate. This requisition slip is the same as that shown in Fig. 5, where, however, it is filled out for another purpose. One of the three copies is retained in the inspection office, and the other two are sent to the head of the tool designing department. When the latter receives them, he initials one and returns it to the chief inspector to indicate the receipt of the order.

This initialed copy is kept in a live file in the inspection office until the gage drawings are delivered, while the other copy is destroyed. All the records of the inspection department are filed according to the number of the part, and not by order numbers; thus, it is always easy to locate all records relating to a given part. Careful drawings of all

INTER DEPARTMENT TRANSFER K 242776

From Dept.	To Dept.	Date
Automatic	Grind	1-5-25

Part Name: Tie-rod bolt — Part No. 59355

Remarks — Order No. — Amt. 5

Inspected or Counted by — Received by

One class of material only to be entered on a transfer. No parts or material are to be received in any department unless a transfer form accompanies same.

Fig. 7. Slip used in transferring Inspected Work to Subsequent Departments, Assembly Lines, or Stock-room

gages are made, so that a legible blueprint record of each gage may always be filed in the inspection office. The drawings are revised whenever a gage is altered so as to keep the record up to date.

There is a great deal of cooperation between the inspection and the tool design departments. Gage designs are freely talked over, with a view to getting as many suggestions as possible, but the final authority for all gage designs rests with the chief inspector. Many ideas in sketch form are submitted by the inspection department. Suggestions are encouraged from the inspectors in the shop and especially from the man who is to use the new gage.

When the drawings for a gage have been completed and delivered to the inspection office, a requisition is filled out in triplicate by the inspection office clerk, as illustrated in Fig. 5. Two of these copies are sent to the department that has charge of ordering all gages, jigs, etc., from either the tool-room or outside sources. The third copy of the slip is kept in the inspection office until the gage is reported ordered. When the tool order department orders the gage, it marks an order number on both slips, files one and returns the other to the inspection office, when the copy on hand is destroyed and the returned one filed. If the initialed copy does not reach the chief inspector within a reasonable time, this fact is constantly brought to mind by reference to the file, and an investigation is made.

Whether a gage is ordered from the tool-room or from an outside concern depends upon the design of the gage and the cost. However, most of the gages are made in the tool-room, because it is cheaper than having them made outside. Thread gages and, of course, liquid gages, micrometers, etc., are all purchased. Before a gage outside of the latter classification is actually ordered, a blueprint of the gage is sent to the tool-room for an estimate of the cost. At the same time bids may be requested from outside companies. All gages on which the estimated cost is less than $25 are ordered direct by the tool order department, but gages costing over that sum must be authorized by the assistant general manager, for the reason that some individual gages cost as high as $800, and it is obviously desirable to bring such costs to the attention of a high executive.

It will be seen from Fig. 2 that the slip on which the work order for a gage costing more than $25 is authorized, must be approved by the general superintendent and the works manager before it can reach the assistant general manager. Five different colored copies of this slip are made out for the assistant general manager, works manager, cost department, division superintendent, and works engineer. All slips are blank on the back, with the exception of the one sent to the cost department. This slip is ruled to permit a record to be kept of the costs of material and labor and other data.

INSPECTION DEPT. GAGE RECORD

PART NO. 53608 MODEL NO.

NAME OF PART Clutch Shaft INSP'D

TYPE	SIZE OF PURPOSE	ORDER NO.	RECEIVED	DEPT. USED IN	FINAL DISPOSITION	DATE
Snap	1.376"-1.374"	W-1416	1-28-25	7	Worn	1-26-26
Plug	0.627"-0.623"	W-2146	2-7-25	14	Size changed	3-4-25
Ring	1.351"-1.349"	W-2213	4-7-25	1		
Indicator	Spacing	A-4127	4-16-25	14		

Machinery

Fig. 6. Master Record Card on which are entered all the Gages used in inspecting a Given Part

REJECTED MATERIAL TRANSFER		K 59926
From Dept. Automatic	To Dept. Scrap Yard	Date 1-5-25
Part Name Tie-rod bolt		Part No. 59355
Operation Spoiled on 3	Last Oper. Performed Finish	Order No.
Charge To Dept. Automatic	Check No. 6748	Pieces Rejected 5

COST PER 100		EXTENSION		SCRAP VALUE
MATERIAL	LABOR	MATERIAL	LABOR	PER 100

Reason: undersize on 0.950" diameter

Rejected by J. Brown Approved by W. Warner

Fig. 8. Form made out by the Final Inspectors when Rejected Material cannot be remachined in the Department in which it was produced

The form shown in Fig. 3 is filled out by the tool order department to give authority to the tool-room to start making gages, both those costing less than $25 and those costing more. When the gage is to cost less than $25, the order number given in the upper right-hand corner is preceded by a W as shown, whereas when the gage is to cost more than that amount, the number is preceded by an A, as in the case illustrated in Fig. 2.

The form is made out in quadruplicate, the first copy being sent to the tool-room foreman, the second to the cost department, the third to the works engineer, and the fourth to the cost department when the gage is completed. The first copy furnished to the cost department differs from the others in that it is ruled for keeping a record of labor and material costs, time, dates, etc.

Recording New Gages in the Inspection Department

Each day the inspection department sends to the tool-room a list giving the sequence in which new gages are required. With this list it is easier for the tool-room to schedule work to meet the needs of inspection. As gages are delivered to the inspection department, they are stricken from the list. An inspector in the tool-room checks all gages to see that the limits are closer than those specified on the work; all gages that must be accurate to within 0.0001 inch are checked in a cabinet having a uniform temperature of 68 degrees F.

The gage is rechecked according to the gage blueprint when it arrives at the inspection office, and the authorization or work number is stamped on it for identification purposes. The date on which a gage is received in the inspection department is then marked on the original requisition slip on the tool order department, which is illustrated in Fig. 5. This slip is next placed in a dead file as a permanent record. A form that accompanied the gage from the tool-room is forwarded to the tool order department to notify that department that the job has been completed.

A record of the gage is entered on a master record card, such as shown in Fig. 6, according to the part number for which the gage is intended. All gages used for a given part are entered on one or more of these cards, which carry the same part number and are filed together. With this scheme, it is easy to determine what gages are required for any part. The record tells the type of gage, important dimensions, authorization or work number, date received by the inspection department, number of department to which it is assigned, and final disposition. When more than one gage of one type is supplied to the department on an order, these are listed separately on the card, so that individual records may be kept. After the master record has been made, the gage is sent to the foreman inspector of the department in which it is to be used.

Gage Orders Originating in the Shop

Sometimes it happens that a gage is required that was not apparent when the blueprint of a new part reached the inspection office. For instance, the personnel of the inspection office may have thought that a gage would not be required for checking a certain roughing or semi-finishing cut, and consequently did not order one for that purpose. If the production and inspection foremen decide that such an operation should be inspected, the foreman inspector makes out a requisition in triplicate on the form illustrated in Fig. 5, giving the important dimensions and other necessary information.

One of these forms is retained by the foreman inspector, and the others are sent to the inspection office. The inspection office investigates the matter, and if the gage is deemed necessary, it is ordered by the regular procedure already outlined. One requisition slip is initialed by the chief or assistant chief inspector, and returned to the foreman inspector, who files it as a record and destroys his original.

DUPLICATE FOR CHIEF INSPECTOR — Departmental Remachine Order — F1475 10M 4-6-25

Dept. 7	Date 1-28-26	Quan. 17
Part Name Clutch shaft		Part No. 61768
Name of Def. Oper. Rough turn		Name of Def. Oper. 6
Instructions Oversize on 1.270" diameter.		Clock No. Man Resp. 2176
		Signature of Insp. J. Barton

Do not use this form to transfer material between departments. This is to be used for Re-machine work within a department only.

Fig. 9. Slip used by Final Inspectors for ordering the Remachining of Work in the Department in which it was produced

The slip kept by the inspection office is attached to the copies of the requisitions made out on the tool design and tool order departments, for a permanent record.

Keeping Track of Instruments Lent by the Inspection Office

All instruments, such as dial indicators, verniers, bevel protractors, and liquid gages, received from outside companies are stamped with identification numbers when they arrive at the inspection office. These instruments are lent to the inspectors throughout the shops, and a checking system similar to that commonly used in most tool-cribs is employed for charging them to the proper persons.

For each of the instruments, a paper tag is hung numerically on the closet door in the inspection office, as illustrated in Fig. 4. This tag gives the number of the instrument and tells just what it is. When an inspector borrows an instrument, he gives a metal tag having a number assigned to him. A second paper tag is then made out on which the number of this check is placed, together with the number of

ORIGINAL — Transfer For Castings and Forgings for: (Tools, Dies, Jigs, Fixtures, etc.)

To Tool-room Dept Date 1-28-26

Delivered by .... Clock No. .... Name .... Dept. ....

Order No.	Pieces	Description—Size and Kind	Pattern No.	Remarks
2114	3	Plug gages for	30960	Grind 1.876" / 1.875"

From Insp. #7 Dept. Received above material .... Dept.

Signed F. Schoch Signed ....

This copy to be left with Dept. receiving Material

F1174 5M 10-27-24

Fig. 10. Form employed for ordering Gage Repairs on the Tool-room

the instrument borrowed. The second paper tag is placed on the first, and the metal check is placed on top of the two. If the check should be accidentally knocked to the floor or otherwise removed, the second paper tag immediately shows to which hook the check should be returned. Each foreman inspector uses a system similar to this to keep track of all gages lent to his men. In the background of the heading illustration may be seen the steel cabinets in which are stowed the gages assigned to one department.

Ordering Gage Repairs

When gages require repairs, they are sent to the tool-room, with the form illustrated in Fig. 10, which is filled out to give the proper information. Snap gage frames are all forged, and when the measuring surfaces become worn too far apart, the frame may often be closed a slight amount and the measuring surfaces relapped to size. Plug gages worn beyond the low limit are transferred to the salvage crib and later reground, if possible, to suit work of smaller diameter. This is also done with other gages that cannot be repaired to suit the job for which they have been employed. For instance snap gage frames may be expanded to make the gage suitable for checking a larger surface than that for which it was originally designed. When gages are sent from the salvage crib to the tool-room, the form shown in Fig. 10 is also used to authorize the work. Indicators and other delicate instruments are repaired by an expert watchmaker, who periodically goes from department to department.

When Work Changes Affect Gages

Blueprints of parts on which changes have been made reach the inspection office accompanied by a yellow slip, as previously mentioned. This slip explains fully what the changes consist of, the reasons for them, and when they take effect. When such a blueprint is received, an investigation is immediately made to see whether the changes make any gages in use obsolete or necessitate any changes in gage design. If they do, the clerk in the inspection office calls in all gages when the changes take effect. Before that, however, new or changed gages are ordered by the usual routine. The inspection department itself often makes recommendations to the engineering division to change the design of parts, when changes would facilitate inspection and not make the part less fit for the purpose it serves.

Forms Used by the Final Inspectors

Authority for transferring inspected parts to subsequent departments, stock-rooms, or assembly lines is given by the final inspectors on the form illustrated in Fig. 7, which is filled out in triplicate. One of these slips is blue, the second white, and the third, a heavy manila paper. The blue slip is kept by the final inspector as a record, the manila slip is tied to the work, and the white slip is sent by the shop mail to the production clerk of the department that is to receive the parts. This white slip advises the production clerk to be on the lookout for work from which the manila slip may in some manner become detached.

Rejected material is sent to the scrapyard with a slip made out as illustrated in Fig. 8. Four copies are made of this form, of which the first is sent to the inspection office, the second to the shop timekeeper, the third to the production clerk of the department in which the parts were made, and the fourth, with the material, to the scrapyard. It will be noted that space is allowed for writing in the check number of the man responsible for spoiling the work. When the rejected material slip reaches the inspection office, the clerk makes a copy for reporting daily to each production foreman the volume of such slips relating to his department received during the previous day. The slip is then filed permanently in the inspection office.

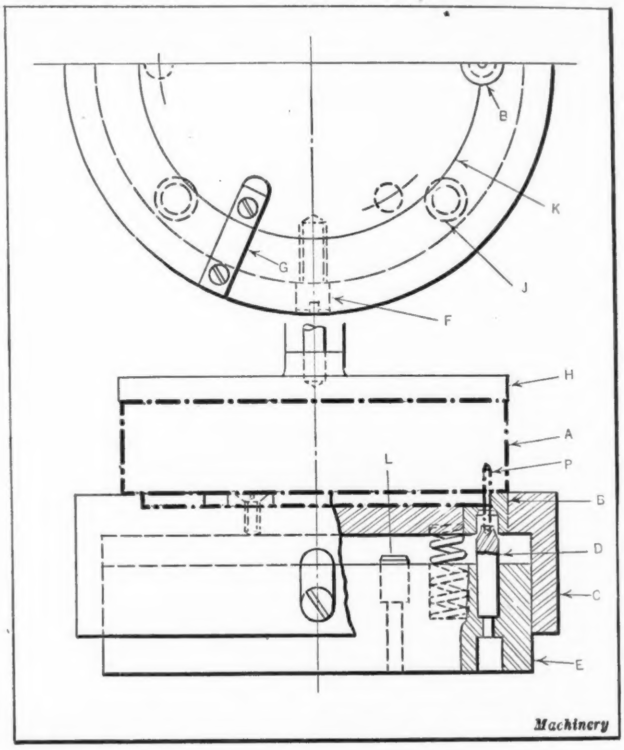
Fig. 9 shows a slip made out by the final inspectors when parts are to be remachined in the department in which they were made. Three copies are made of this form, one of which goes to the production clerk of the department, and another to the chief inspector. The third slip is attached to the parts.

DOWEL-PIN ASSEMBLING FIXTURE

By B. J. STERN

The pressing of a dowel-pin, 0.070 inch in diameter, into place in a finished brass casting presented quite a problem until the fixture shown in the accompanying illustration was designed. This fixture is mounted on a small foot press, and operates in the following manner: The dowel-pin *P*, to be set in place, is slipped through bushing *B* in plate *C*, until it rests in the cavity in the head of pin *D*. When thus positioned, the pin is flush with the top of plate *C*, which is a close fit over plate *E*, being retained by screws *F*. The casting *A*, shown by the heavy dot-and-dash lines, has a finished shoulder which is next inserted in a corresponding recess in plate *C*.

The pin-hole in the casting is lined up with the pin by the key *G* which fits a finished slot in the casting. When the work is in place, the operator brings down the ram *H*, forcing down the casting *A*, which, in turn, pushes plate *C*



Fixture for setting Dowel-pin in Place

down over plate *E* against the tension exerted by the four springs *J*. This downward movement continues until it is stopped by the pins *L*, at which time pin *P* is forced into the proper position in casting *A*.

* * *

NEW OAKLAND PLANT

According to information obtained from the Austin Co., of Cleveland, Ohio, a contract has been placed with this company for the building of a $6,000,000 automobile plant for the Oakland Motor Car Co. at Pontiac, Mich. The new plant will comprise over 2,000,000 square feet of floor space, including a machine shop of single-story design, 455 by 880 feet; an assembly building, 180 by 1260 feet, of three-story and basement construction; a foundry, 300 by 700 feet; and a car storage building, 432 by 760 feet. The entire site of the plant covers more than 100 acres of ground on the Grand Trunk Railroad, about one mile from the present Oakland plant. Over four miles of railroad siding with loading docks are to be built to accommodate 200 railroad cars per day. The Fisher Body Co. has a plant adjoining the new Oakland plant, and the bodies will be furnished by this company to the automobile plant by means of conveyors. It is expected that the work on the new plant will be completed by January, 1927.

Pin Gearing

Methods of Laying Out—Advantages for Watch and Clock Mechanisms—Second of Two Articles

By L. E. KING

IN the first article on this subject (see September MACHINERY, page 35), it was pointed out that pin gearing may be regarded as a special form of epicycloidal gearing: that is, if the pins or rounds have zero diameter (are lines only) they would be driven, or would drive, with a constant angular velocity ratio if in contact with teeth having epicycloidal faces. The correct epicycloid for the faces of the teeth would be generated by rolling the pitch circle of the pin gear on the outside of the pitch circle of the gear. In practice, the pins are given size and the epicycloids modified, as described later.

As pins can only drive before the line of centers, and only be driven after the line of centers, they are only suitable for followers. The gear with pins is usually small in comparison with its toothed driver, and so it will hereafter be referred to as the pinion. The pitch diameter of such a pinion is the diameter of the circle passing through the center of its pins or rounds. The complete solution of the procedure in laying out a gear and pinion will now be given. Assume that the gear has 60 teeth of 65 pitch, and the pinion 8 rounds, 0.016 inch in diameter.

Then

$$\text{Pitch diameter of gear} = \frac{60}{65} = 0.9231 \text{ inch}$$

$$\text{Pitch diameter of pinion} = \frac{8}{65} = 0.1231 \text{ inch}$$

$$\text{Center distance} = 1/2\ (0.9231 + 0.1231) = 0.5231 \text{ inch}$$

$$\text{Pitch angle of gear} = \frac{360}{60} = 6 \text{ degrees}$$

$$\text{Pitch angle of pinion} = \frac{360}{8} = 45 \text{ degrees}$$

In making the lay-out of the gear and pinion, it is best to choose a large scale so that the work may be done with sufficient accuracy. About seventy-five times size is suitable in this case. On account of space, however, the scale of Fig. 4 has been reduced.

After constructing the pitch circles and the line of centers, lay off the pitch angles on each. As the number of rounds in the pinion is small, divide the pitch circle by trial when the number of rounds is such as to make that necessary. The pitch angle of the gear may most readily be laid out by multiplying the tangent of the pitch angle (6 degrees in this case), by the center distance. Lay off the distance *BG*, thus found, from *B* at right angles to the line of centers. Through *G* and the center of the gear, draw line *GH*, then *DH* will be the desired pitch arc. Lay off from *H* the point *J*, so that the chord *HJ* is equal to the radius of the pinion rounds.

It may be noted here that this last procedure is not exactly correct, but it is so nearly so that it will introduce no appreciable error. The point *J* thus located will be taken as the starting point for the epicycloid to be constructed by rolling the pitch circle of the pinion on the pitch circle of the gear. This can conveniently be done as follows:

Lay off the points 1, 2, 3, etc., on the pitch circle of the gear, so that the arcs between each successive point are equal. The total space thus laid off should be about 25 per cent greater than the pitch arc. Through *B* draw the arc *KL*, with the gear center as the describing center. This will be the locus of the center of rolling circle. Through *J*, 1, 2,

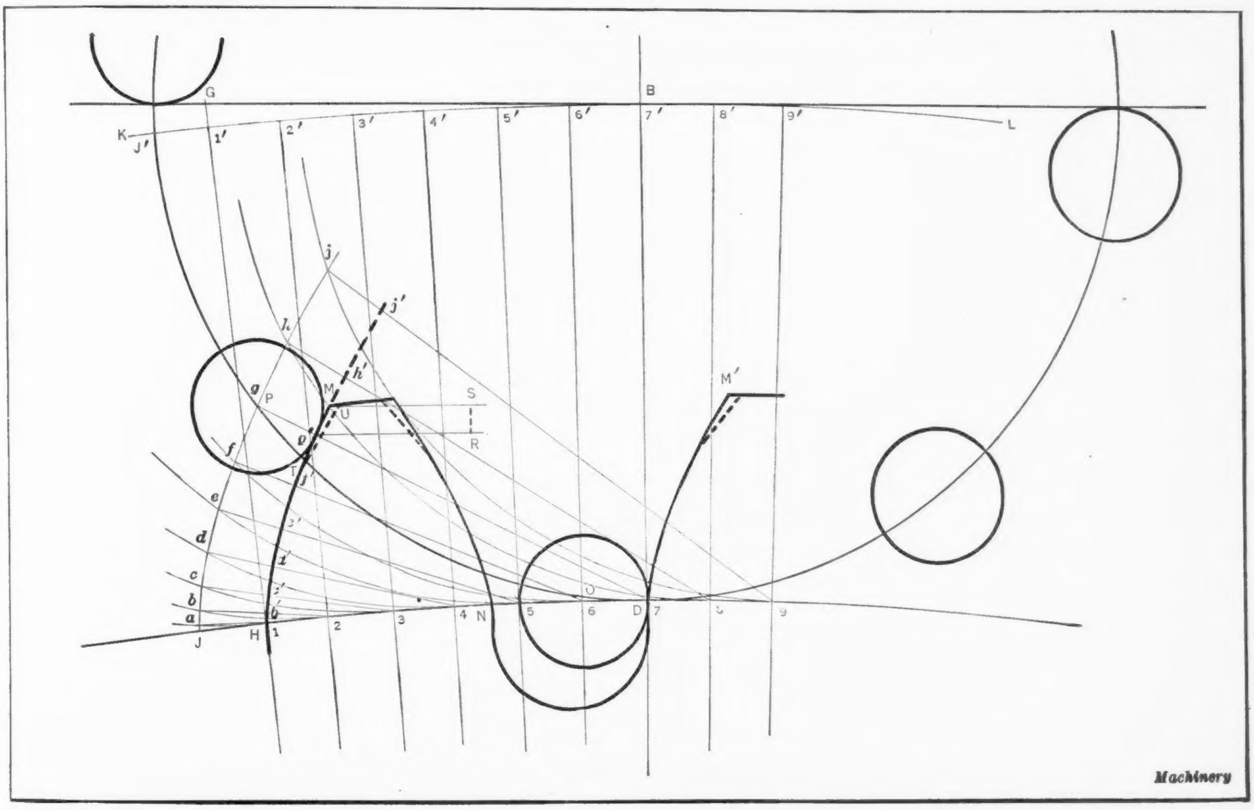


Fig. 4. Enlarged Diagram showing Method of laying out Gear Tooth Curves for Pin Gearing

3, etc., draw radii to the arc KL. The points J', $1'$, $2'$, $3'$, etc., thus found, will be the respective centers of the rolling circle when it is in contact with the pitch circle of the gear at the points J, 1, 2, 3, etc. With points $1'$, $2'$, $3'$, etc., as centers, draw the arcs $1a$, $2b$, $3c$, etc. On these arcs lay off the points a, b, c, etc., so that arc $1a$ = arc $1J$, arc $2b$ = arc $2J$, arc $3c$ = arc $3J$, etc. Then by the definition of an epicycloid, points a, b, c, etc., must be points of the desired epicycloid. The curve is completed by drawing a smooth curve through the points thus found.

In laying off the equal arcs, it may be convenient in some cases to determine the location of the points a, b, c, etc., by calculating the lengths of the chords $1a$, $2b$, $3c$, etc. For clearness, this may be illustrated by carrying through the calculations for four points of the curve. In order to distribute these calculated points along the curve, angles measured on the pitch circle of the gear will be taken as 2, 4, 6, and 8 degrees. These angles are measured from the starting point J.

Let

α = angle from starting point J on pitch circle of gear to point of contact of rolling circle;

β = corresponding angle through which rolling circle has turned;

R = radius of pitch circle of gear; and

r = radius of rolling circle = pitch radius of pinion, in pin gearing.

Then since the corresponding arcs must be equal,

$$R\alpha = r\beta \text{ and } \beta = \frac{R}{r}\alpha$$

The chord of angle $\beta = 2r \sin \frac{\beta}{2}$.

In pin gearing, since R and r are equal to the pitch radii, we have $\frac{R}{r} = \frac{\text{number of teeth in gear}}{\text{number of teeth (rounds) in pinion}}$. For the example in hand we have: $\beta = \frac{60\alpha}{8} = 7.5\alpha$, and the chord of angle $\beta = 2 \times \frac{0.1231}{2} \times \sin \frac{\beta}{2} = 0.1231 \times \sin \frac{\beta}{2}$.

The results arranged in tabular form are as follows: (The values in the last column can be calculated quickly by the aid of logarithm tables.)

α (Degrees)	β (Degrees)	$\frac{\beta}{2}$ (Degrees)	Chord of $\beta = 0.1231 \sin \frac{\beta}{2}$ (Inches)
2	15	7.5	0.01607
4	30	15.0	0.03186
6	45	22.5	0.04711
8	60	30.0	0.06155

Machinery

Laying Out the Gear Tooth

The epicycloid constructed as just described is correct for a pin having no thickness. To find the derived curve that will work correctly with a pin of given diameter, lay off from the points a, b, c, etc., (Fig. 4) on chords $1a$, $2b$, $3c$, etc., points H, b', c', etc., so that the lengths aH, bb', cc', etc., are equal to the radius of the given round. If through the points thus found a curve be drawn, it will be the required curve. This construction is in accordance with the principles explained in the preceding article, as the chords $1a$, $2b$, $3c$, etc., are the common normals to the two curves in contact—the pinion round (circle) and the derived curve.

Since, by construction, HD is the pitch arc on the gear, the next succeeding gear tooth face will be at D. Through D draw curve DM' the same as HM. Locate point N on the gear pitch circle so as to give the desired clearance for the rounds of the pinion. Through N a curve is drawn that is exactly the same as curves HM and DM' except in the reverse order, thus forming the back face of the tooth. Draw pinion rounds O, P, etc. The center of round P, in this case, will be at g, and the contact point with the curve HM will be at g', on the normal (chord) gD. Through g' draw $g'R$ at right angles to the line of centers BD, and draw MS also at right angles to BD, making RS sufficient to allow for any incorrect center distance or errors in center location, allowable in the class of work for which the gear and pinion is being designed. This fixes the length of the tooth and hence the outside diameter of the gear.

To construct the root of the tooth opening, draw radial lines through D and N and join them with an arc of a circle, the center of which is so located that there is ample clearance between the rounds of the pinion and the bottom of the opening to allow for incorrect center distances, allowable errors in the location of the gear and pinion centers, and for dirt. This completes one tooth and one tooth opening, and is all that is required to determine the features of the design. However, as many more teeth as desired could easily be constructed by merely transferring the curves through the pitch angle of the gear.

Number of Rounds, Their Size, and the Proportions of the Teeth

In designing gears of this class, a satisfactory solution will evidently depend upon the number of rounds and their size, the pitch, and the gear ratio. In general, from a manufacturing standpoint, it is desirable to have the size of the rounds as large as possible and the teeth as large and as few as possible. From a functional point of view, these are both limited by the requirement that the arc of action must be somewhat greater than the pitch. Also assuming that the center distance is approximately fixed, the larger the teeth, the fewer the number of rounds in the pinion, with the resulting increase in the obliquity of action. The best solution to meet the conditions in hand cannot readily be predetermined by calculation, but can best be found by trial lay-outs. For some classes of work satisfactory solutions can be made for pinions having only six rounds.

It should be noted that the action begins at D (Fig. 4), on the line of centers, the center of the round being past the line of centers an amount equal to its radius. The action evidently ends when the tooth and pinion round reach such a position that a line from D to the center of the round passes through the point M of the tooth.

The length of the tooth should not be made to conform to some arbitrary rule, such, for example, as to give an action 20 per cent greater than the pitch. For small numbers of rounds, the obliquity of action is very much greater at the end of the action than it is with larger numbers of rounds; hence a given increase in the length of the tooth measured parallel to the line of centers will afford the same protection against errors in construction, whether the number of rounds be large or small. A given per cent increase in the arc of action, however, would produce a very much greater increase in the length of tooth required in the case of a small number of rounds than it would for a large number of rounds, and such an arbitrary rule is not applicable.

In general, in gears of this class for use in watches, clocks, instruments, etc., space considerations will determine the center distance between the gear and pinion. Preliminary calculations, taking into account the class of service and cost of manufacture, will determine the approximate number of rounds to be used in the pinion. The required gear ratio will then determine the number of teeth in the gear, the center distance being slightly adjusted so that with the number of teeth chosen, which must be a whole number, the pitch will be a whole number. Whether the pitch is a whole number or not, is, however, of secondary consideration. A lay-out should be made to see if the chosen pitch, number of teeth, number of rounds, and size of rounds will give the necessary arc of action and sufficient width of tooth at the outer end after allowance for irregularities in manufacture has been made for the class of service under consideration.

As stated before, it is desirable that the pitch be as coarse as possible and the rounds as large as possible in order that the manufacturing cost may be as low as is consistent with

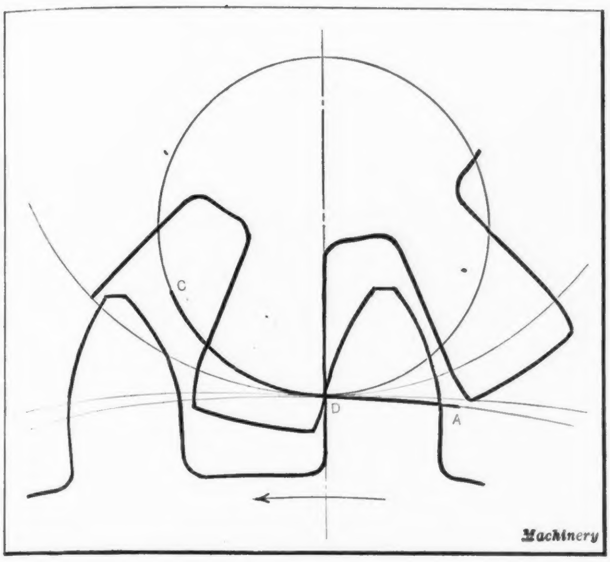


Fig. 5. Pinion of Die-cut or Drawn Type and Gear designed to give Maximum Action after Line of Centers

satisfactory functioning of the gears. It will readily be seen that the smaller the number of rounds in the pinion, the coarser may be the pitch, and the smaller the rounds, the greater the arc of action. Also that the smaller the number and size of rounds, the greater will be the maximum and average obliquities of action.

As these matters are in conflict and as the best proportion is impractical for calculation, it is best to find the most suitable proportion by trial lay-outs. Within quite a limited range the following table will afford a rough preliminary guide as to the size of round to be used:

No. of Rounds in Pinion	Gear Ratio	Diam. of Round / Circular Pitch
6	8:1	0.25
7	8:1	0.29
7	8 1/3:1	0.31
8	7 1/2:1	0.33
9	6 1/4:1	0.42

Machinery

For pitches from 50 to 80, the minimum clearance between the round and the teeth, when the round is on the line of centers, may be about 15 per cent of the diameter of the round plus 0.001 inch. For the same pitches, the clearance between the round and the bottom of the tooth opening may be about 15 per cent of the circular pitch plus 0.005 inch. The bottom of the tooth opening is made a circle, because this form gives the maximum strength and durability to the punches and dies and also to the cutters for making the broaches and the punches, and at the same time gives maximum strength to the teeth for a given amount of clearance.

Effect of Errors in Manufacture

The common errors in manufacture may be enumerated as follows: (1) Incorrect distance between centers of gears; (2) eccentricity of gear or pinion or both; (3) incorrect pitch diameter of gear or pinion or both; and (4) incorrect spacing of rounds in pinion.

If the center distance is too small, rounds too close together, pitch diameters of gear too large, or pitch diameter of the pinion too small, the entering round will be held away from its corresponding tooth; that is, round *P* (Fig. 4) would hold round *O* out of contact, so that when *P* went out of action there would be a sudden "drop" on round *O*. Likewise, with the center distance too great, or the rounds too far apart, or the pitch diameter of the gear too small, or the pitch diameter of the pinion too large, the entering round *O* would come into contact with its corresponding tooth before the line of centers, and round *P* would go out of action before the point of contact reached the end of the tooth. In this case, there would be a small amount of "butting friction." Eccentricity of gears or pinions would evidently, for moderate amounts, have effects partly similar to large center distances and partly similar to small center distances depending upon whether the small radius or the large radius was on the line of centers.

When round *P* holds round *O* out of contact, and there is a sudden "drop" when round *P* goes out of action, this condition is more harmful than a slight amount of action before the line of centers. It is therefore evident that the tolerance on the center distance should be plus. Thus it should be, say, 0.5231 $\begin{matrix}+0.0010\\-0.0000\end{matrix}$ inch, for the design shown in Fig. 4. But as this tolerance in itself would not take care of eccentricity of the gear, or pinion rounds that are too close together, a gear having a pitch diameter that is too large, or a pinion having a pitch diameter that is too small, it is proposed to alter the tops of the teeth as shown by the dotted lines in Fig. 4.

The amount of this chamfer should be determined in accordance with the tolerances to be allowed for eccentricity, etc., that cause this undesirable "drop." With reasonable tolerance limits, a slight amount of chamfer will entirely overcome this difficulty, with only a very slight influence on the uniformity of the angular velocity ratio, and only a very small amount of action before the line of centers. Thus in Fig. 4 the top of the tooth has been decreased by 0.003 inch, the chamfer starting not over 0.004 inch below *g'*. This would be ample for gears for cheap clock work.

Comparison of Pin Gearing with Epicycloidal Gears Having Cut, Drawn, or Punched Pinions

In Fig. 5 is shown a gear and pinion for the same problem as represented in Fig. 4, the pinion in this case being of the die-cut, drawn, or punched type. Here the diameter of the generating circle for the dedenda of the pinion and the addenda of the gear is equal to the radius of the pitch circle of the pinion, and the diameter of the generating circle for the addenda of the pinion and dedenda of the gear is equal to the radius of the gear. This will make radial flanks on the teeth of both the gear and pinion, and will give the maximum action after the line of centers. Only sufficient addenda has been given to the teeth of the pinion so that there would be ample arc of action and suitable allowance for the manufacturing tolerances. As in Fig. 5 the gear is the driver, the path of the point of contact between the teeth will be along the shaded portions of the generating circles from *A* through *D* to *C*.

By referring to the illustrations, it will be seen that there is action before the line of centers in the cut pinion, and none with the pin gear. The maximum obliquity of action after the line of centers is much greater in the case of the cut pinion than in the case of the pin gear, and also the average angle is somewhat greater. As the rounds in pin gearing are made of steel and the gears of brass, the nature and shape of the contacting surfaces offer less engaging friction than in the cut pinions, for the same amount of care in making. For a given maximum or average obliquity of action after the line of centers, the pin gear may have fewer rounds in the pinion and a coarser pitch than the cut pinion and gear.

In the pin gear shown in Fig. 4, the action starts at an obliquity of approximately 3 degrees 43 minutes, and reaches a maximum obliquity of about 26 degrees 13 minutes, the average being nearly 14 degrees 50 minutes. In Fig. 5, the obliquity of action after the line of centers starts at 0 degrees and reaches a maximum of about 34 degrees 7 minutes, the average being approximately 16 degrees 48 minutes.

Summary of the Advantages of Pin Gearing

In conclusion, it may be stated that the pin gear is particularly well adapted for the time trains of watches and clocks, and for instrument work, where the gear is the driver. Its advantages and disadvantages may be summarized as follows:

1. The action is all after the line of centers, which condition cannot usually be attained with cut epicycloidal gears and pinions, and not at all with involute gearing.

2. The maximum and average obliquity of action is less, or conversely, it is possible to use a smaller number of rounds in the pinion and coarser pitches, than can be done with cut gears and pinions. Because of this fact, pin gears are particularly well suitable for cheap watch and clock work.

3. Because of the comparatively smooth hard round surfaces of the pinion rounds, the engaging frictions are less in pin gearing than in gears with cut pinions.

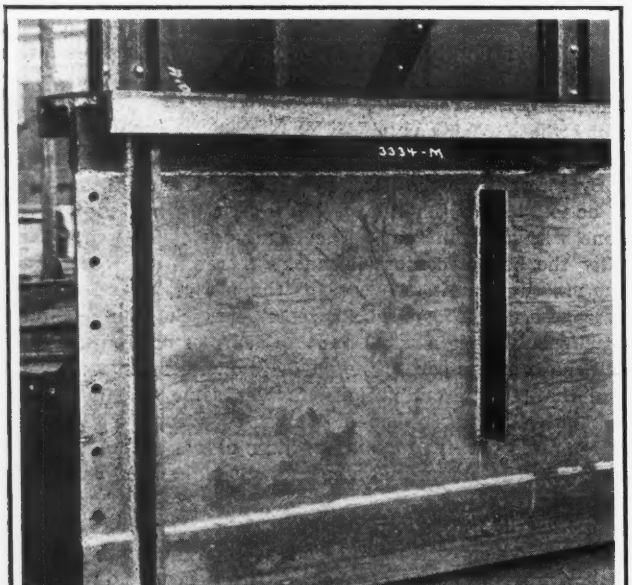
4. The application of pin gears is limited by the construction, greater axial length generally being required than in the cut pinion.

5. Because of condition (4) and the difficulty of making very small pinions of sufficient strength and rigidity, pin gears are not well adapted for very small watch work. The difficulty of making the very small pinions is, however, partly due to the lack of automatic machines of the required precision, suitable for this work.

* * *

AN ARC-WELDED CRANE RUNWAY

Electric arc welding, instead of riveting, was employed to fabricate all members of a large crane runway recently constructed at the Coplay Cement Mfg. Co., Coplay, Pa., by the Morgan Engineering Co., Alliance, Ohio. This installation comprises sixteen supporting frames and fourteen girders, each 35 feet long, totaling approximately 65 tons of steel, which gives a runway 245 feet long. There are 1800 feet of continuous bead on the girders and 2035 feet of intermittent welds on the same members. On the supporting frames, there are 596 feet of continuous bead and 403 feet of intermittent welding. The runway has seven bays, and the span from center to center of the rails is 100 feet. Twelve of the supporting frames are 21 feet 11 inches high, while the other four that support the roof over a portion of the runway are somewhat higher. The load on the runway from each of the four crane wheels is 55,300 pounds plus 25 per cent for impact. The time required for welding the girders



Crane Girder constructed by welding Structural Steel Members and Plates together

totaled 1050 hours, and for the twelve supporting frames, 320 hours.

As may be seen in the illustration, the girders were made up of a web plate 42 inches wide by 1/2 inch thick, with two 6- by 4- by 5/8-inch angle-irons at the top, covered by a 15-inch channel iron. A bottom flange was made up of two 6- by 6- by 9/16-inch angle-irons. The backs of the angle-irons were set 3/8 inch from the edge of the web plate, and then welded to that plate. Flat bars were also edge-welded to the web, and top and bottom angle-irons to act as stiffeners. The cross-pieces, plates, and angle-irons were simply joined together with different types of beads to construct the supporting frames.

* * *

STANDARDIZATION OF PREFERRED SIZES

According to information published by the American Engineering Standards Committee, 29 W. 39th St., New York City, some companies are using the national standards as a basis for preparing suitable standards for their own needs in their own plants, selecting from the whole range of standards such sizes as best meet their own requirements. In this connection, it is mentioned that the Pratt & Whitney Co., Hartford, Conn., with a view to diminishing the number of sizes carried in stock, has outlined a simple and effective expedient in some of its own work. The following table shows an excerpt from a possible list of screw sizes, given merely as an example.

Lengths	Diameters						
	1/4	5/16	3/8	7/16	1/2	9/16	5/8
7/16	X		X		X		
1/2		X		X		X	
9/16	X		X		X		X
5/8		X		X		X	
11/16	X		X		X		X
3/4		X		X		X	
13/16	X		X		X		X
7/8		X		X		X	
15/16	X		X		X		X
1		X		X		X	
1 1/8	X		X		X		X

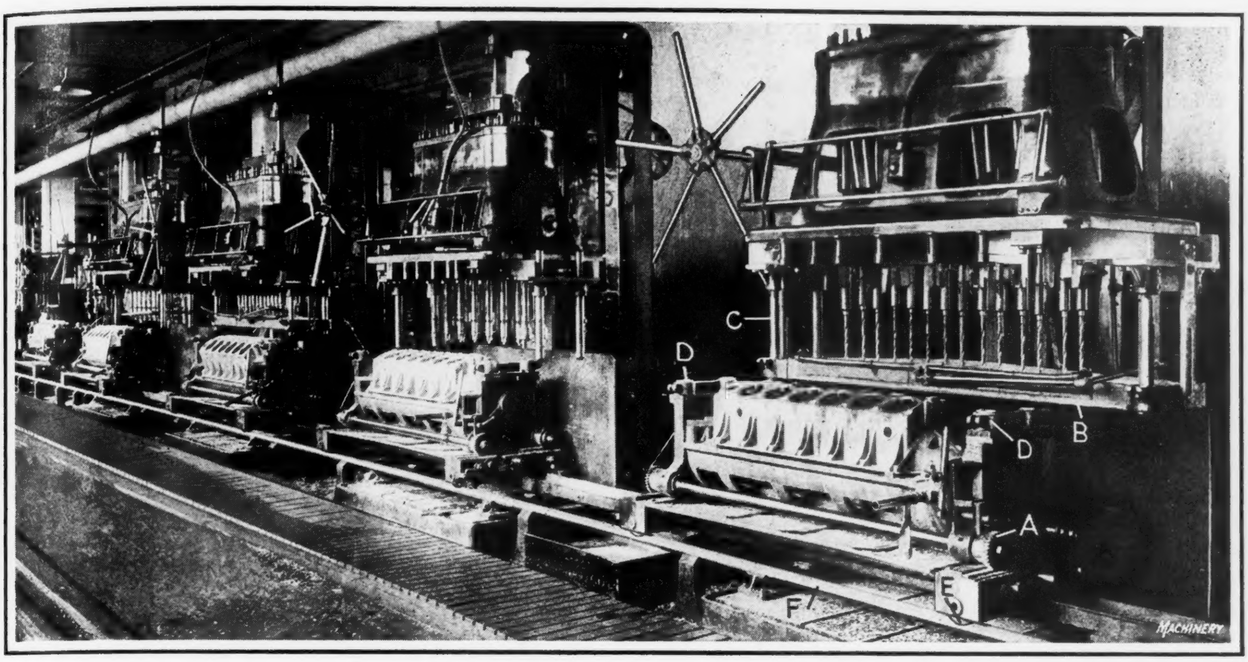
Machinery

The list of standard lengths is written in the left-hand column, while the standard diameters are the headings of the other columns. Instead of checking every standard length in a given range for every diameter, only every other length is checked, thus reducing the number of different combinations of diameter and length to one-half. Moreover, the lengths so checked are staggered in adjacent columns, which gives the opportunity of selecting the length required with a very small change in diameter, when the exact combination of length and diameter wanted does not appear on the list. Earle Buckingham, who furnished this illustration, points out that if, for example, a diameter of 1/2 inch is desired with a length of 7/8 inch, the diameter can be changed to 7/16 or 9/16 inch, whereas, if retaining the diameter is more important, a stock screw can be had by changing the length to 13/16 or 15/16 inch. There are thus four alternatives, and few cases will arise where one of these will not serve practically as well as the size originally wanted.

* * *

WELDING EXPOSITION IN BUFFALO

The welding exposition to be held in connection with the annual fall meeting of the American Welding Society at Buffalo, N. Y., November 17 to 19, promises to be one of the largest welding exhibits ever displayed. New developments in welding apparatus and supplies will be shown, and a large variety of welded products will be exhibited. The technical sessions include papers and discussions on "The Design and Development of Welding Apparatus"; "Organization of Welding on the Railroads"; "Welding of Locomotive Parts"; "Welding Science in the Engineering Curriculum of Universities"; and "Arc Welding in a Gaseous Atmosphere." An inspection trip through one of the Niagara Falls power houses has been arranged for Friday afternoon, November 19. A meeting of the American Bureau of Welding and of the welding wire specifications sub-committee will be held in connection with the convention.



Multiple Drilling Operations on Engine Parts

By WILLIAM F. SANDMANN

THE three major castings of the average automobile engine—the cylinder head, crankcase, and pan—each contain dozens of drilled, reamed, or tapped holes. The economical production of these holes is one of the principal items of machine work on the engines, and ranks even higher in importance than the milling operations, being second only to boring. Obviously, the machine tool for producing the holes is a multiple drilling machine of some kind. The exact type of machine, however, and its application to the work can only be determined by a thorough analysis of the individual problem. The kind of machine or machines needed and the jig and fixture equipment necessary depend on the production requirements to a considerable extent. Each of the machines shown in the accompanying illustrations has been designed to meet a specific drilling requirement, and is a product of the National Automatic Tool Co., Richmond, Ind.

Engine builders having a small output or producing a number of different models with the same equipment must keep the tooling costs down to the minimum. For this class of work, flexibility is more desirable than high production rates. A multiple drilling machine for drilling the oil-pan holes in the bottom of the crankcase of a six-cylinder engine is a good example of simplicity in multiple drilling equipment. A simple plate jig is used which is clamped in the proper position on the crankcase. The crankcase rests directly on the table of the machine, and is lined up under the drills by hand. The drilling operation is quickly accomplished, but it requires several minutes to align the jig plates on the crankcase and remove and replace the work. When a certain number of cases have been drilled on the oil-pan side, the spindles of the machine are rearranged and the cylinder head holes drilled. A plate jig is used for this operation also. When ready for tapping, the spindles are set properly, and the holes tapped on the same machine, but without using the jig plate.

In Fig. 2 are shown two multiple drilling machines employed for drilling the detachable type of cylinder block. An open type box jig is used on the machine in the foreground. The operator simply tips the jig toward him to unload and reload it. The blocks are located by studs which fit the bores of the cylinders and are held in place by the bar clamp *A*.

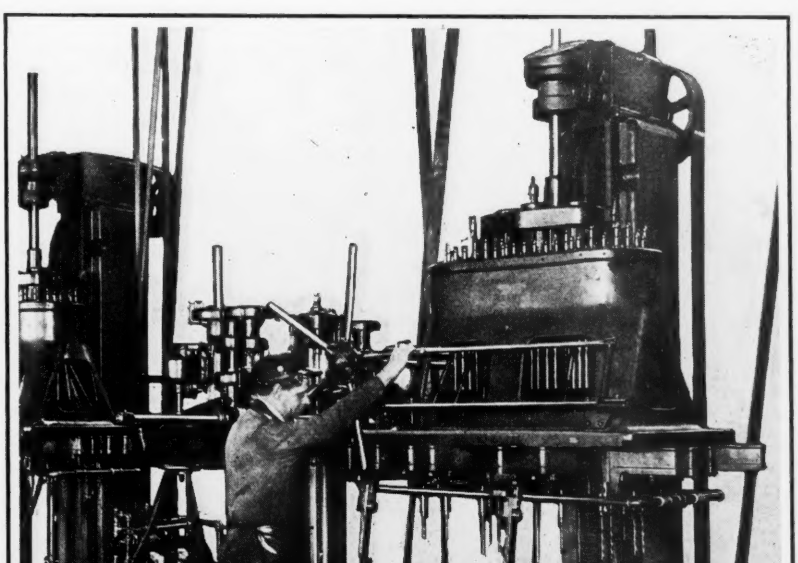


Fig. 1. Fixture Track System used in drilling Oil-pans

The drill bushings *B* are for a later drilling operation, at which time the block is reloaded in the jig and drilled with a different arrangement of spindles.

The machine shown in the background is used for drilling holes in the top of the block. In this case, a simple plate jig is used to guide the drills. It is apparent that the equipment for drilling is very inexpensive, the jig on the machine in the foreground simply being made up from three plates bolted together.

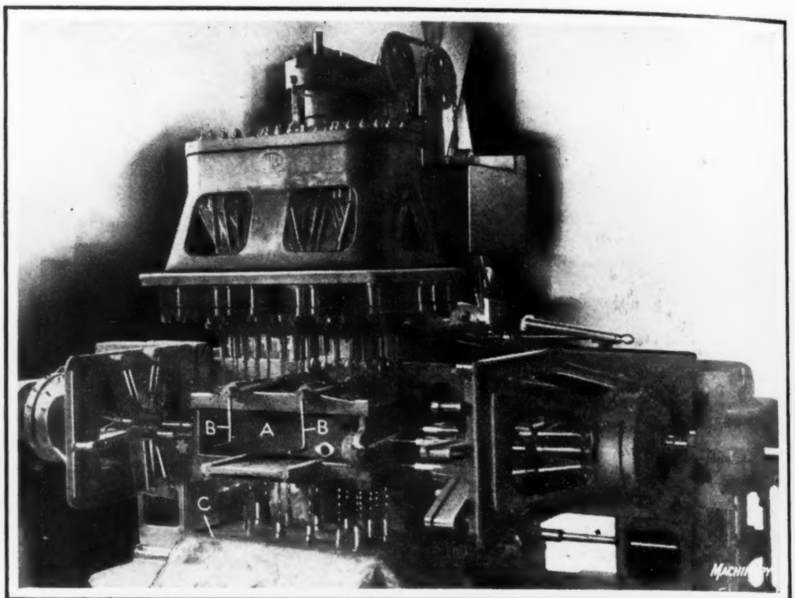


Fig. 3. Drilling Four Sides of Lower Part of Crankcase simultaneously

Special Multiple-spindle Four-way Machine

When high production is required, either of two methods may be employed. One method is to build a special machine for the job, and the other is to use what is known as the progressive fixture track system. The special machine, drilling from several sides at once, doubtless provides the most rapid means of completing the part. Fig. 3 shows such a machine arranged with four heads for drilling the top, bottom, and both ends of the lower part of a crankcase. The part to be drilled is shown in the jig at *A*. It is clamped securely in place by the two cranks *B* which operate clamping cams. The four heads move inward simultaneously, and the four sides of the piece are drilled in the same time that it takes to drill the deepest single hole.

It will be noted that all the spindles on this machine are fully adjustable, so that if the location of a hole is changed, no change is necessary in the machine. A great many four-way machines are built with fixed spindles. This construction, of course, gives greater rigidity, but the gain in structural strength is obtained at the expense of flexibility, and when the hole locations are changed, the fixed spindle heads must be discarded and new ones provided. The adjustable spindle machine has its drawbacks also, because any drilling that is done on this type of machine must be accomplished within the necessarily narrow limits of travel of the heads and spindles. The canvas cover *C* over the lower head of the machine shown in Fig. 3 serves to keep the chips from falling between the spindles. The three-way machine shown in Fig. 4 is of the same general type as the one shown in Fig. 3, and is employed for drilling the top and ends of a "straight-eight" engine crankcase.

The progressive fixture track arrangement makes use of standard machines, but the fixture cost is comparatively high, and in some cases, the installation costs more than a special three- or four-way machine. It has gained favor, however, because of its flexibility. A typical progressive track type fixture installation for drilling the crankcase of a V-type twelve-cylinder airplane engine is shown in the heading illustration. The fixture is of the indexing type, mounted in a carriage which is rolled under the drilling heads of the various machines on a narrow-gage track. An interesting feature of this fixture is the provision made for shifting the crankcase back under the head of the machine in order to perform certain drilling operations. This is accomplished through the rack and gear shown at *A*, by means of which the fixture is rolled in and out.

The drill bushings are located in the suspension plate *B* which is hung from the drilling head. As the head of the machine is lowered, the suspension rods *C* are pushed down through the plate *B* and into the bushings *D* in the fixture. This brings the plate into correct alignment with the crankcase. The fixture wheels at *E* are equipped with roller bearings. The front wheels, or those nearest the operator's platform, have a V-groove which serves to line up the fixture longitudinally, while the rear wheels are flat. The track *F* is made from 2-inch cold-rolled steel.

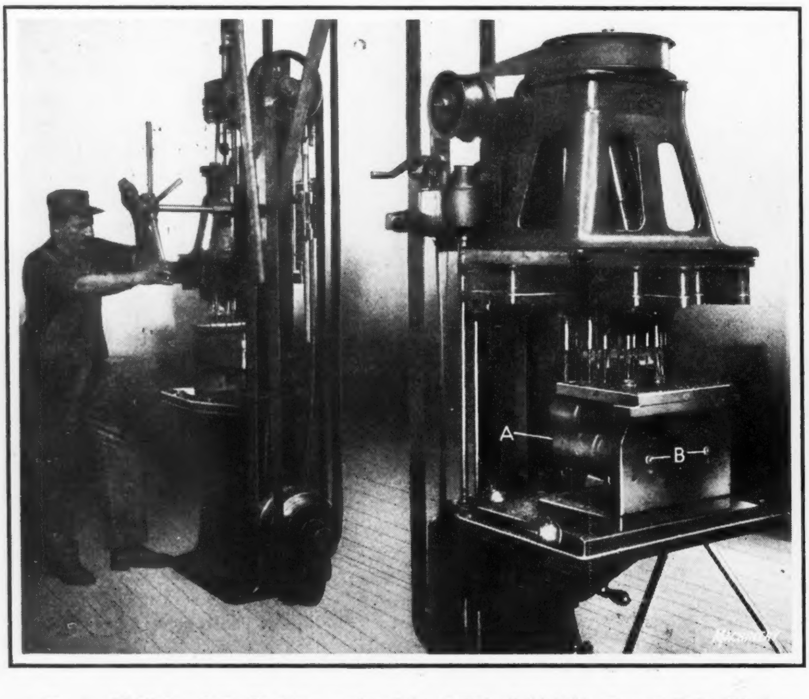


Fig. 2. Multiple-spindle Machines equipped for drilling Detachable Type Cylinder Block

The second machine has no suspension bushing plate, but it is provided with rods *C* to locate the fixture for the tapping operation which is performed at this station. As each operation is finished, the fixture is moved under the next machine. When the end of the line is reached, the drilling operations on the case are completed, and the work is removed. The fixture is then moved to the rear of the line of machines by means of a transfer table, and is returned down another track to its starting position where it is reloaded. A completed case is produced every time the head of the last machine in the line is lifted at the end of the operation.

In Fig. 1 is shown another fixture track system on which oil-pans are drilled. The fixtures are of simple design and require no indexing movements. It will be noticed that a standard light weight rail track is used, and that brushes *A* are attached to the fixture to keep dirt and chips off the track. At intervals along the track are pieces of flat steel like the one shown at *B*. A notch is

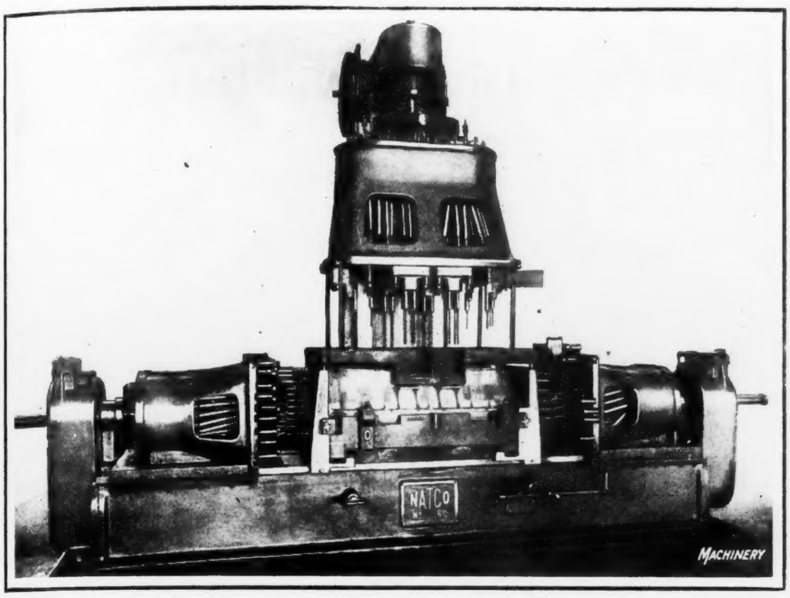


Fig. 4. Machine employed for drilling "Straight-eight" Engine Crankcases

cut in the upper side of each of these pieces which is used for locating some of the fixtures under the machines. One of the fixtures having a plunger on the side of the base which is located in the notch of one of the plates is shown in Fig. 5.

Several closely grouped machines used for drilling marine engine parts are shown in Fig. 6. The large fixture in the foreground contains the crankcase. The limits within which the swing of the fixture was required to be confined made it necessary to counterbalance the weight of the crankcase with weights *A*. The top of the crankcase is drilled under the first machine, after which the operator turns the handwheel at the right-hand side of the fixture which operates a worm and worm-wheel device that indexes the cradle of the fixture 90 degrees and brings the side of the case in position to be drilled under the second machine. After each operation, the cradle is indexed and the fixture moved under the next machine. When all four sides are drilled and tapped, the crankcase is removed from the fixture shown and put in another fixture for drilling the two ends. The latter operation completes the drilling, tapping, and reaming of all the holes in the crankcase.

The design of track systems gives the fixture designer an opportunity to display his ingenuity, inasmuch as there are many points to be considered that are never encountered in any other type of jig or fixture. The cradles should fit the track fixture in such a way that they can be readily removed and another cradle for a different part substituted. Another important point to be considered in the design of track systems is to build the fixtures so that no great effort is required to move them back and forth on the track. The design of three- and four-way machines like those illustrated, on the other hand, involves problems that must be handled by a special machine designer.

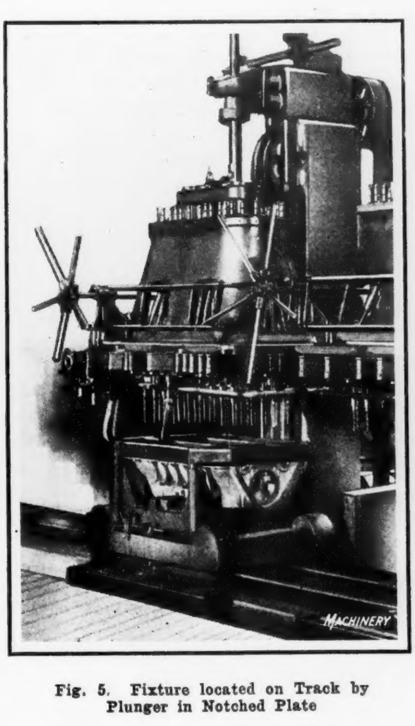


Fig. 5. Fixture located on Track by Plunger in Notched Plate

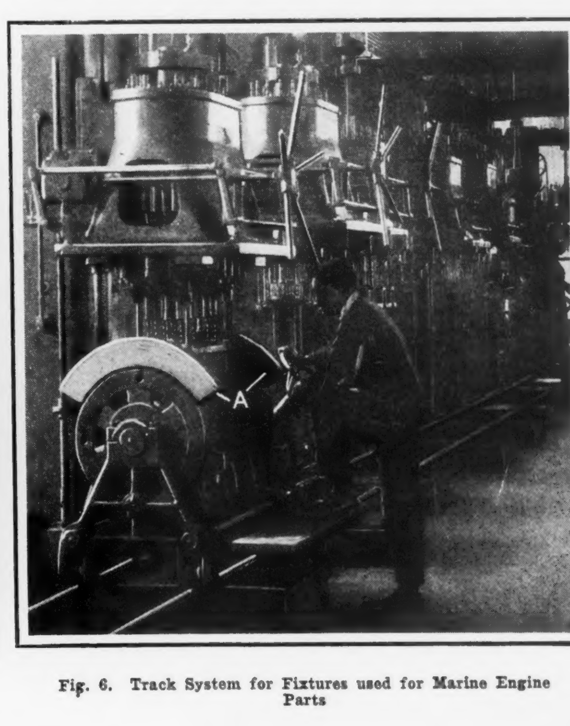


Fig. 6. Track System for Fixtures used for Marine Engine Parts

THE FOUNDRYMEN'S CONVENTION

As MACHINERY goes to press the American Foundrymen's convention opens in Detroit, beginning September 27 and continuing for one week. The convention gives promise of being the largest gathering of foundrymen that the industry has ever seen. The technical program is excellent in character, and there are more than 250 exhibitors of equipment and supplies used in the foundry industry. Practically nothing is lacking that can be used in a foundry—from cranes and furnaces to nails and chaplets. The foundryman that visits Detroit during the thirtieth annual convention and exhibit of the association will see the best examples of equipment available for the industry. He will also have an opportunity to listen to reports on the research work conducted by committees of the association, and to discussions on almost every problem that confronts him in his everyday work.

The technical program schedules twenty-two sessions from Monday to Friday, inclusive, covering almost every phase of foundry practice—ferrous and non-ferrous metals, the handling of materials, cores and core binders, permanent molds, cupola practice, steel foundry, malleable iron and gray iron practice, the casting of nickel alloys, the testing of cast iron, foundry refractories, foundry sand, elimination of waste, and apprentice training.

* * *

IMPROVED CAST IRON

The McMyler Interstate Co., Cleveland, Ohio, announces that, as the result of a number of years of research and tests, it has developed a new type of iron for castings. The new product, known as "Mico-Iron," is of close grain, uniform in texture, and less breakable than ordinary castings. It is said to have long wearing qualities and considerable strength, and to be especially suitable for castings for machine tools, gas engines, air compressors, gears, high-pressure valves, and rolling mills. It can be readily machined, and surfaces requiring long life can be chilled without affecting the machineability of other surfaces. The tensile strength of "Mico" cast iron is stated to vary from 32,000 to 35,000 pounds per square inch.

Cold Finishing of Metals in Interchangeable Manufacture*

By E. V. CRANE, Staff Engineer, E. W. Bliss Co., Brooklyn, N. Y.

ONE of the most severe of all press-working operations is the squeezing of steel in the cold state. Depending upon the shape of the work and the design of the dies, the working pressure may climb to 100 tons per square inch or more on the surface of the product. Cold squeezing, or the working of metal in compression in power presses, may be divided into four classifications, as follows:

First, sizing, flattening or surfacing of forgings, stampings or castings, with very little reduction of thickness. This is the least severe of the cold working operations.

Second, swaging, cold forging, or upsetting, where a suitable blank or slug is forced into a desired shape to save machining operations, usually involving considerable reduction of thickness in some portions, but characterized by considerable unrestricted freedom of flow.

Third, coining, stamping, or embossing, where the metal, fairly well confined and usually in comparatively thin sections, may be forced to flow to fill the shape and profile of the dies.

Fourth, extrusion, where the metal is forced to flow evenly through an orifice of whatever shape, being otherwise confined. This process is quite limited as to metals and applications, and is considered as outside the scope of this article.

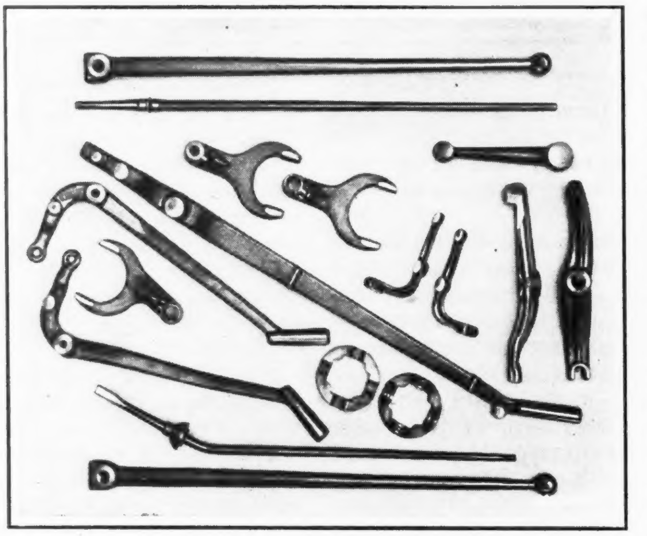


Fig. 1. Drop-forged Automobile Parts on which Flat Surfaces, Bosses, etc., have been squeezed to Size in Knuckle-joint Presses

In all four classes, the metal must be squeezed beyond its elastic limit in compression. The deformation takes place as sliding along the slip planes of the crystals, resulting, where the deformation is considerable, in appreciable reduction of grain size and hardening of the material. If it is desirable, the original grain size can again be approximated by suitable annealing after the squeezing operation.

Sizing of Forgings

Under the first classification, where the metal is ordinarily not displaced appreciably and such flow as occurs is not restricted, the most general application and the one receiving most attention at this time is the sizing of drop-forgings. Fig. 1 shows a random selection of drop-forged automobile parts on which flats, angles or boss faces have been squeezed to size in knuckle-joint type presses. The object is to squeeze the boss surfaces of the unfinished forgings accurately to size, so that the usual milling or grinding operations are eliminated. The division of the General Motors Corporation which furnished these samples advises that the usual tolerance for such work is $\pm$ 0.001 inch. This is fairly representative, and is closer than tolerances ordinarily allowed on the milling of similar parts.

The dies for sizing bosses are usually plain blocks with comparatively large surface area, so that the forging need not be located with especial care. Under favorable conditions, one operator and one press can size cold four to ten times as many parts as can be milled or ground by one operator with a suitably rigged machine, and where the quantity is sufficient and the shape of the part is adaptable, a magazine-type push feed can be applied to the press and the production increased by another twenty-five or fifty per cent.

The forging to be sized may have a number of different finished surfaces at varying levels which are taken care of by corresponding steps in the die. The relative heights of such bosses on the sized forging are found more reliable than they would be if the piece had been machined. Sizing of forgings is not limited to the flat surfaces of bosses. Rounds, bevels, sides, tapers, flanges—even the inner surfaces of punched holes—can be sized smooth and accurate. One thing to watch, especially in sizing steel, is to have ample space for the free flow of the metal, and not to restrict it so that the pressure builds up. A certain amount of restriction is possible when necessary, but it necessitates greater care in the construction of the die, and the life of the dies is proportionately reduced. It is of interest to note that forging a depression in the center of the bosses, as in the case of the shift levers at the sides in Fig. 1, reduces the area, prevents pyramiding of pressure at the center, which is hard on the dies in case of a large-area squeeze, and localizes any deformation at the ends of the boss.

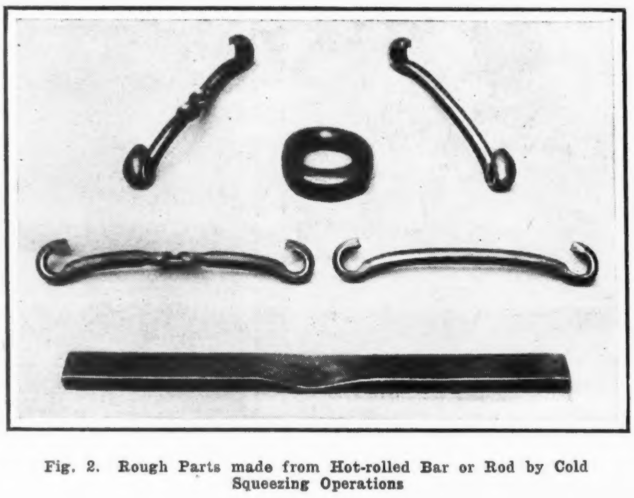


Fig. 2. Rough Parts made from Hot-rolled Bar or Rod by Cold Squeezing Operations

Allowances Required for Sizing

The usual finish allowance for work of this character is 1/32 inch and in some cases 1/16 inch. More can be allowed, but is not required. It may be pointed out that if the rough forgings vary considerably, the pressure which the press is called upon to exert will vary considerably. Accordingly, if the press is not heavy and of rigid construction, it will spring

*Abstract of a paper presented at the technical sessions held in conjunction with the New Haven Machine Tool Exhibition, New Haven, Conn., September 7-10.

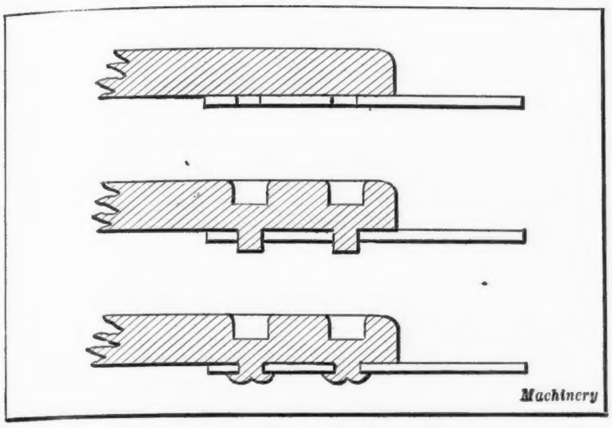


Fig. 3. Riveting by Cold Squeezing

in proportion to the load, giving a possible variation beyond the tolerance. It is best to figure the pressure requirement for sizing work (close tolerance, small compression, free flow) at about 60 to 80 tons per square inch of surface to be squeezed; 400-, 600-, and 800-ton capacity presses seem to have proved the most satisfactory for the general run of automobile forgings.

Sizing of Castings

Another line of work under the first classification is the sizing of castings. Many brass, bronze, aluminum, and alloy castings, and some steel and malleable castings, lend themselves to cold sizing and surfacing methods. The bosses on the two L-shaped cast brake levers at the bottom in Fig. 1 are squeezed to size. In such cases, the same general comments apply as have been made on the sizing of drop-forgings, except that the pressure requirements run lower for the softer metals and somewhat higher for the steel and malleable castings. Another application of coining methods to castings is found in the preparation of some classes of hardware for plating. The surface of the casting can be coined sufficiently smooth to eliminate or greatly reduce the preparatory hand work and buffing. The pressure required for such a job is likely to run about 90 tons per square inch of projected area.

Between the first and second classification are a variety of squeezing and sizing jobs on which either the pressure required is not great or accuracy is not essential. In Fig. 2 are shown a number of rough parts made from hot-rolled bar or rod employing cold squeezing operations. The piece at the bottom shows two wedges after the first squeeze which forms the taper. A sharper-edged squeeze will all but complete the wedges and sever them. Above, in the center, is a link made of a round rod formed with the two ends overlapping. The ends are then squeezed together cold, making a strong job without welding. The other links shown are also made from round rod. The space for the ends (two ends together) is flattened; the links are parted in a second die, then formed, and returned to the knuckle-joint press to coin the two eyelets at the center. Accuracy is not essential in these jobs, and for a mild steel the pressure requirement is about 80 to 90 tons per square inch of area squeezed.

It may be of interest to note here a type of riveting from the stock, involving cold squeezing. Equipment has been built for the Ford Motor Co. for riveting a spring steel vibrator to a steel bridge piece. As illustrated in Fig. 3, the vibrator is previously punched, and the two pieces are fed into the dial feed in proper relation. At the working position, the plain round punch descends, forcing some of the metal down through the hole in the vibrator. The die is so arranged, however, that the metal is turned back at the edge as it comes through, completing the riveting in one stroke of the press. This equipment is operated at a production rate of about sixty assemblies per minute.

The Cold Forging Process

Distinctly in the second classification (swaging, cold forging, etc.), combining great accuracy and severe working stresses, are a quantity of odd shaped pieces squeezed to shape out of solid metal for parts for adding machines, sewing machines, speedometers, typewriters, electrical equipment, toys and novelties. Fig. 4 shows a typical press for this sort of work, a 400-ton knuckle-joint press swaging an adding machine wheel.

To start with a simple case, at the bottom of Fig. 5 are shown the operations in the production of a medium-hard steel cam lever. At the left is the blank, pierced and blanked from strip stock. Next the grip portion of the lever (extending to the front) is squeezed top and bottom as it lies, to round up the corners and end. The third operation is a squeeze which bends and flattens the grip portion to its final shape. Fourth, the cam-way is squeezed into the head portion, reducing the metal thickness there by nearly fifty per cent. Fifth, the edge around the head portion is shaved smooth, so that the completed lever is ready for plating. Here, in five quick press operations including three squeezes, a lever has been turned out which would otherwise require hot forging and considerable hand work. Above this at the right is a plate in which flanges have been squeezed to about half the original thickness of the metal, down each side of the three deep slots. Before this method was adopted for this operation, it was necessary to machine out the flange-ways with a small end-mill.

On all samples of this class of work, the blank is so designed that no more metal has to be squeezed down than is absolutely necessary. Note also that in the pieces which have a boss, hub, or other portion higher than the rest of the piece and left so by squeezing down the metal around it, there is a tendency in the process to drag down the corners and edges of such high parts. To minimize this tendency, it is often advisable to use a medium hard stock, and if necessary, arrange the dies so that they will strike the high part at the end of the stroke and size it off. There may be considerable variation in the pressure required for this work on account of the area and thickness relation. For practical cases, however, with a free flow relief all around, 100 tons per square inch or higher can be figured on the area squeezed, for steel, and 75 tons per square inch for copper.

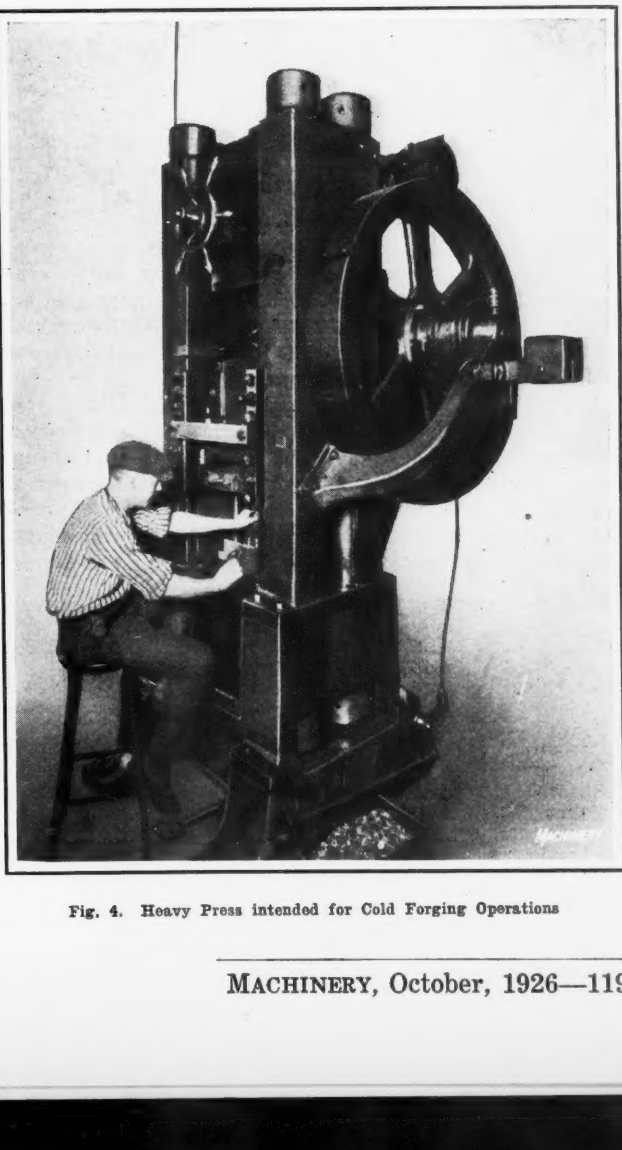


Fig. 4. Heavy Press intended for Cold Forging Operations

Coining, Stamping, and Embossing

Under the third classification, coining, stamping, and embossing, comes a variety of work in which the metal is made to flow comparatively little, but is subjected to extremely high pressures to bring out sharp designs or lines or to obtain a very accurate surface. On most of this work the metal is either completely contained in a closed die or practically so, with the result that there is no outlet or relief for the flow of surplus metal. Under such conditions, if care is lacking and oversized stock is used, or adjustments are carelessly made, the pressure may amount to several hundred tons per square inch, and seriously affect the equipment.

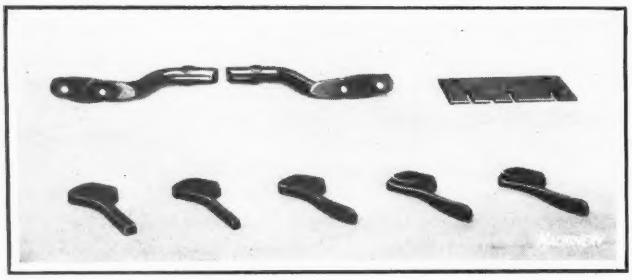


Fig. 5. Examples of Cold Swaging Work

The best known application is, of course, government coinage. A report issued some time ago by the mint showed that the actual pressures required to bring up clear impressions on United States gold, silver, and copper coins vary between 85 and 125 tons per square inch. The actual presses used have two or three times the capacity that these figures would indicate to take care of the difference between static test loads and quick stroke working loads, and to guard against such overloads as are likely to occur.

A sharp impression depends upon pressure but also to a very great extent upon die construction. Fifty tons can bring up a sharper, better looking job than five hundred if the dies are arranged to pinch just where the sharp lines are desired, and relieved elsewhere, so that the metal can flow a little.

Material Used for Dies

Difficulties experienced thus far with this type of work have been due largely to the selection of too light a press, improper planning of the operations so that high local pressures cut down the life of the dies, and unsuitable steel for the dies. It is dangerous to recommend steels for this sort of work, as so much depends upon proper hardening and drawing, and steel-treating methods vary extremely. The author has, however, compiled a list of steels for cold-swaging dies (Table 1) to which others, possibly better, could be added, and which is offered only on the ground that successful users of cold finishing processes have found them satisfactory. The variety in their analyses indicates how varied are the opinions of what is best.

Under normal conditions the life of the tools on this sort of work appears to vary from twenty to forty thousand pieces per grinding. It has been found that the life of some steels can be prolonged materially, by redrawing them, at the redressing periods, to slightly above their original drawing temperatures. This may be accounted for by a tendency to surface crystallization, under the severe repeated stresses, that is, a formation and spreading of minute fatigue fractures between the crystals—a condition which is corrected by the annealing. Another recent "stunt" found to prolong the life of simple dies is to electroplate a thin, hard, smooth layer of chromium, say 0.001 or 0.002 inch over the die steel. It is advisable, especially when brittle steels are used, to pay careful attention to stiffness both in the press bed and in the die holder, and even to back up the die steel with other hardened plates, to prevent deflection which might permit cracking.

TABLE 1. A FEW STEELS THAT HAVE BEEN SUCCESSFULLY USED FOR COLD FINISHING DIES

	Styrian Purple Label	Crucible H.V.C.C.	Colonial Special	Colonial 7D	Vasco K	Recommended by A. R. Kelso
Carbon.....	1.08	2.25	0.96–1.05	0.85–0.95	0.76–0.85	0.67–0.80
Manganese.	0.21	0.30	0.20–0.30	0.20–0.30	0.10–0.30	0.20–0.30
Silicon....	0.22	0.40	0.10–0.20	0.10–0.20	0.20–0.35	0.05
Vanadium..	....	0.20	....	0.18–0.20	0.15–0.25	trace
Chromium.	....	12.00		....	0.70–0.90	0.09
Phosphorus	0.002	0.03–	0.015–	0.015–	0.03–	0.010
Sulphur....	0.009	0.03–	0.025–	0.020–	0.03–	0.021

Machinery

Knuckle-joint Presses are Suited for Cold Swaging Work

All of the cold swaging and coining work is characterized by a rising load, reaching a maximum at the very end of the stroke. This load is effective through a very short distance, and since the area of the work is small in proportion to the load, it admits of a proportionately more compact machine than any other type of press work. The modern knuckle-joint press fits into these requirements in every respect.

In the selection of a knuckle-joint press, it is impossible to over-emphasize the need for selecting a press heavy enough. The life of the dies, the accuracy of the product, and the life of the machine itself depends upon it. It has been well said that a power press is the most abused machine tool there is. Remember that a static load registered on a testing machine is not the same as the load the press must withstand. The slide is driving down at the rate of thirty, forty, fifty strokes a minute, with all the inertia of the flywheel back of it; and if the press is properly put together, the die surfaces will come to the same place every time, practically regardless of what is between them. That is essential if the product is to be held to close tolerances. Further, the blanks, forgings, slugs, strips, stampings, and castings do not come uniform; some are thicker than others, some are harder than others; and beside this, press operators are no more careful than the general run of humanity. One general rule much followed is always to double the static test load to determine the press capacity required. Examination of reports of one of the large automobile manufacturers, pioneers in the sizing of drop-forgings, shows that their press selections are made on a basis of about 200 tons per square inch of area to be squeezed. Another automobile concern, starting out with a 250-ton press which did the work, jumped to a 400- and then a 600-ton machine, getting increased die-life and accuracy each time.

TABLE 2. COMPARISONS OF INCREASED PRODUCTION

Part Name	Percentage of Increase Over the Machining Method	
	Manual Feed	Mechanical Feed
Accelerator lever	387	583
Accelerator lever	430	537
Brake lever	1042	1864
Brake lever	780	944
Clutch yoke	358	894
Fan supporting yoke...........	624	774

Machinery

Automatic Feeds Increase Production

Sizing operations are fast, as a rule, because the pieces do not have to be accurately placed on the die. Good hand-feeding practice appears to range between ten and thirty pieces per minute. For the swaging and coining operations, the work usually has to be accurately placed and the rate is lower, say five to fifteen a minute. On almost any of this work, however, where the production is large enough to warrant it, the application of a mechanical feed will materially increase the output. Table 2 is based on information given by A. R. Kelso, showing increases recorded at the Hudson Co.

A New Plan for Making the Press Shop Safe

How Serious Accidents have been Eliminated in a Large Metal Stamping Plant

By P. J. EDMONDS, General Foreman
Westinghouse Electric & Mfg. Co.

POWER press departments are often considered more hazardous than other machine shop departments, primarily because of the danger of getting fingers caught in dies when inserting or removing work. However, by the provision of means that reduce the likelihood of such accidents, press departments can be made as safe as others. As far as safety is concerned, the metal stamping shop is considered one of the model departments in the plant of the Westinghouse Electric & Mfg. Co., at East Pittsburg, Pa. Even though between 475 and 525 men are regularly employed in this department, serious accidents seldom occur. Last year there were only 43 accidents, and most of them were of minor importance, such accidents as slight cuts or bruises predominating. The most serious accident required the amputation of part of a finger. As a matter of fact, most of these accidents resulted from handling sheet steel and dies and not from the operation of machines. Every accident from which the injured person lost any time at all is included in the number mentioned.

How Accidents Have Been Reduced

Instead of equipping dies with guards that compel the operator to keep his hands from the vicinity of the punch and die as the ram makes the downward stroke, the operator is provided with various types of appliances that make it unnecessary for him ever to place his hands in the danger zone. This is the principal feature of the plan adopted in this shop for the elimination of accidents. Operators are positively forbidden to use their hands instead of the devices provided for placing material into and removing it from the dies. Some machines are equipped with a two-handle control, which requires the operator to use both hands to effect the downward stroke of the ram, but even the operators of such machines must use devices for placing the work in the dies and removing it. Then, too, employes are constantly reminded of the danger lurking in the careless operation of presses.

In the heading illustration, the operator is provided with a vacuum device for sliding 10-inch circular lamination blanks into the die from a stack at his right. The suction is readily turned on and off in the device by means of a valve in the handle. With this vacuum device, a production of between 700 and 800 laminations is maintained per hour. About 125 machines in the stamping department are equipped with similar vacuum appliances, and these are all connected by pipe lines to one central vacuum pump. On some machines where large sheets are pulled forward between the dies from a stand at the rear of the machine, a two-handle suction device permits the operator to use both hands in sliding the sheets into the proper location.

Fig. 1 illustrates an operation in which 1000 six-inch diameter stator laminations are blanked per hour from circular scrap steel. With a quick jerk of his left hand, the operator slides a disk from a pile into approximately the correct position in the die. He then uses a wooden stick in his right hand to shift the lamination into the exact punching location. The stick has a small felt pad attached to it so that it will not slip on the metal disk. When the disk is in place, the operator trips the press, and as the ram ascends at the

Fig. 1. Operator using a Wooden Stick to place Work in the Die and remove it at the End of an Operation

Fig. 2. Press equipped with a Gravity Feed for feeding Partly Formed Work into Redrawing or Trimming Dies

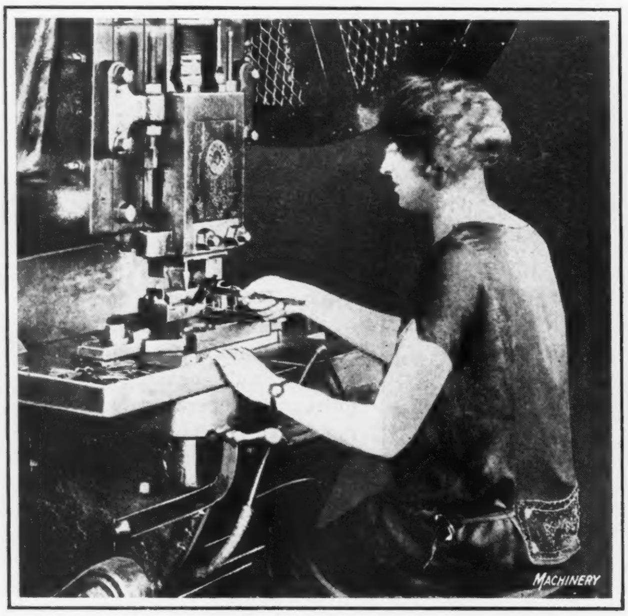


Fig. 3. Using a Pair of Tweezers to obviate the Necessity of putting the Hands in the Danger Zone

Fig. 4. Machine with Two-handle Control which keeps Both Hands away from the Die when the Press is tripped

end of the operation, he catches the lamination with the stick as it falls from the stripper. The operator piles the finished pieces at the front of the machine and at the same time, uses the stick to clean off any scrap from the die.

Men employed in this and similar operations soon become very dexterous, and perform the feeding and removing of work quicker than the eye can follow. If the press should be accidentally tripped, the only damage would be a severed stick and a ruined piece of work, since the hands of the operator never are put under the die.

Safety Two-handle Control

Tweezers are used extensively for placing work in dies and for removing it at the end of an operation. Fig. 3 shows the use of tweezers in connection with a small flat piece, and Fig. 4 in connection with a small cup-shaped part. In both of these examples, the tweezers are merely an extra precaution, since the machines are equipped with two-handle controls. It is necessary for the girl to hold down a lever at her right and another at her left, in order to trip the machine. The operation of the control mechanism can be understood from the illustration of a working model, Fig. 6, and the drawing, Fig. 8.

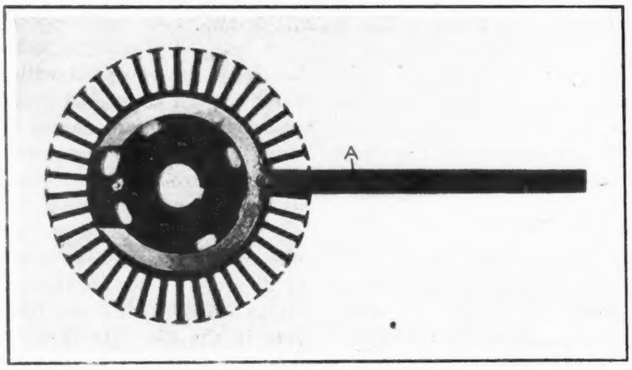


Fig. 5. Magnet of Simple Design used in handling Work

In order to trip the press, it is necessary to pull rod *A* downward, and this can be accomplished only by depressing handle *B*. However, to operate handle *B*, it is necessary also to hold handle *C* down. The two handles are mounted on shaft *D*, handle *C* being pinned to the shaft, while handle *B* rides loosely and may be moved independently around the shaft. Handle *B* has a long hub, as seen clearly in the drawing, and to this hub is attached a spring-actuated bar *E*, which normally holds the handle upright. A similar bar *F* is fastened to shaft *D* to hold handle *C* vertical when it is not pushed down.

Mounted on the right-hand end of shaft *D* is a cam *G* which lowers lock *H* when handle *C* is pushed down. Teeth on the upper end of this lock normally engage teeth on the lower side of rack *J* and prevent horizontal movement of the rack through the operation of handle *B*. However, when the lock has been pulled down in the manner described, the rack is pulled toward the operator as handle *B* is depressed, through the action of

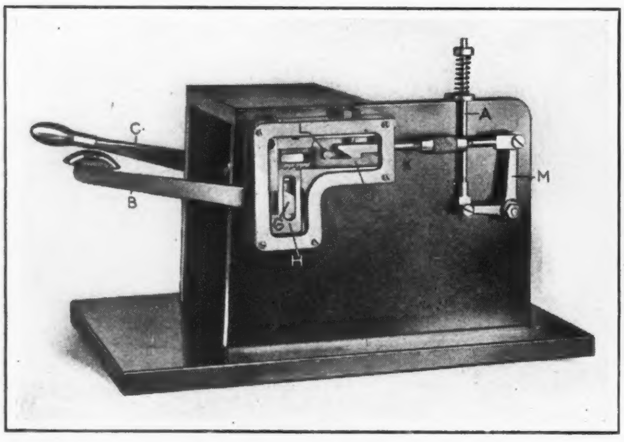


Fig. 6. Working Model of the Two-handle Control provided on Various Punch Presses

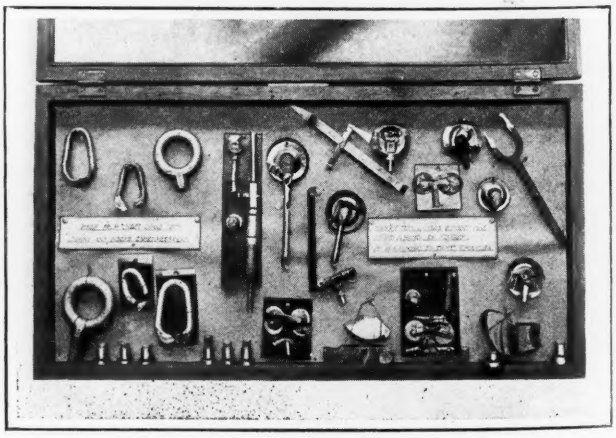


Fig. 7. Exhibits that impress the Employes with the Importance of being Careful

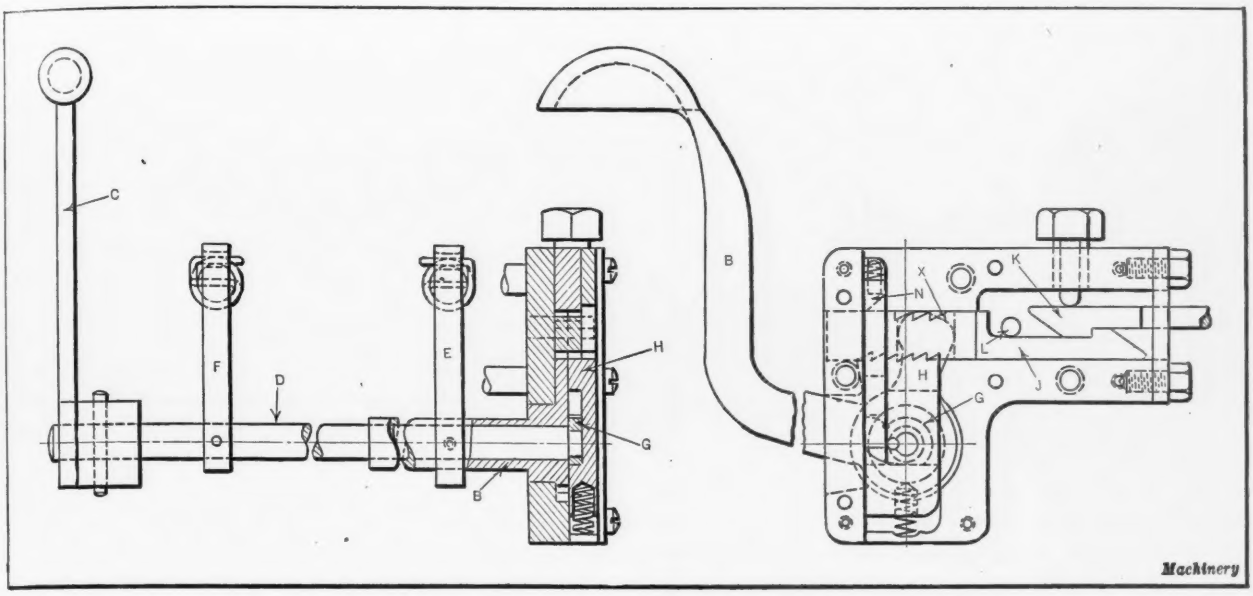


Fig. 8. Drawing of the Safety Two-handle Control Mechanism for Power Presses, shown in Fig. 6

lug X on handle B, which engages a slot in the rack. When the rack is pulled forward, it draws rod K with it, causing the forward end of this rod to ride up over pin L. As this occurs, the opposite end of the rod imparts a slight movement to the bellcrank lever M, and this movement, in turn, is imparted to rod A, thus tripping the press.

The rack is locked in the tripping position as long as handle C is depressed, by the spring-actuated trip-lock N engaging teeth on the upper side of rack J. When handle C is released, cam G forces lock N upward, allowing rack J, rod K, rod A, and handle B to assume their normal positions.

In operating some machines, use is made of a simple magnetized piece, such as shown at A, Fig. 5, for placing the laminations in the die and removing them. Also, some operators use the simple suction device illustrated in Fig. 9. The holding end of this device is provided with a rubber bulb within which a vacuum is created when pressure of the hand is released after the diaphragm end has been placed on a piece to be put in the die. The diaphragm end is disengaged from the piece by pressing the bulb slightly.

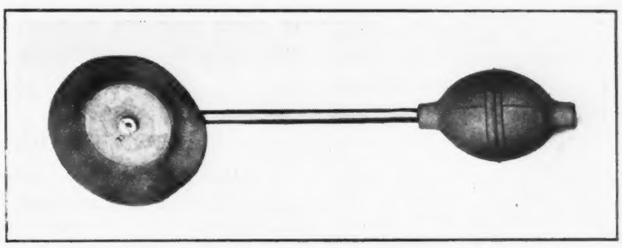


Fig. 9. Simple Hand Suction Device used in Certain Press Operations where the Work is Flat

Gravity-fed Dies

Pieces partly formed can often be fed into redrawing or trimming dies by gravity. For work of this character, the dies are equipped with a gravity slide, as illustrated in Fig. 2. In a trimming operation, the part falls into a box under the press, and the scrap is ejected from the die by air, so that it is entirely unnecessary for the operator to place his hands in jeopardy. Fig. 10 shows three styles of dies equipped with slides for feeding the work into place. Two of these dies are arranged for ejecting the work by means of compressed air. The spring of the left-hand die is used for stripping the finished part from the die.

Keeping Employes Interested in Accident Prevention

One man in the metal stamping shop spends his entire time in the promotion of safety. Not only does he work toward the removal of hazards in operations, but also toward getting all employes to cooperate in trying to eliminate accidents. Signs and exhibits are used to impress upon employes the importance of constantly exercising care in the operation of presses.

The case illustrated in Fig. 7 is prominently displayed in the department. At the left-hand end of the case are examples of chain links and eyebolts that have been broken in carrying work through the shop with an overhead crane. These specimens emphasize the importance of not going under crane loads. At the right-hand end of the case are shown tweezers, vacuum devices, a magnet, etc., used in placing work in the dies. These have all been broken through the

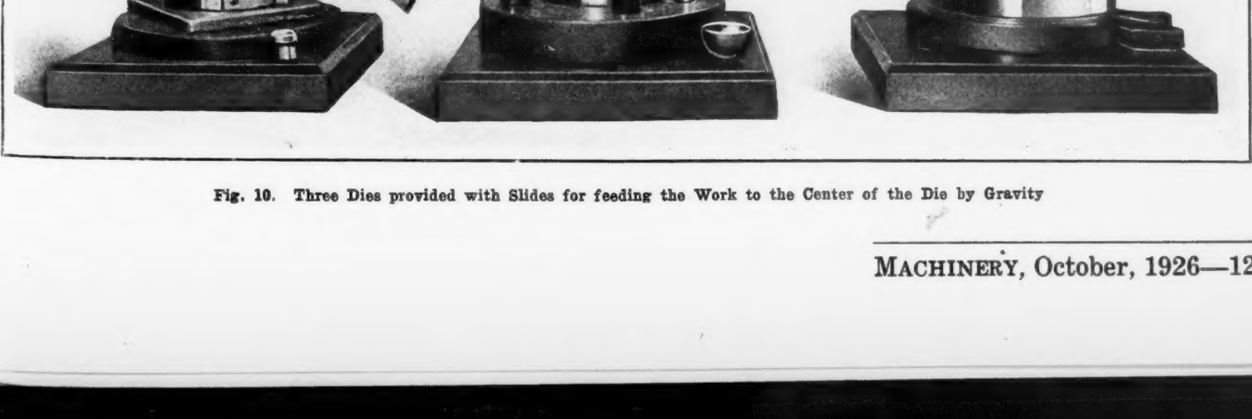


Fig. 10. Three Dies provided with Slides for feeding the Work to the Center of the Die by Gravity

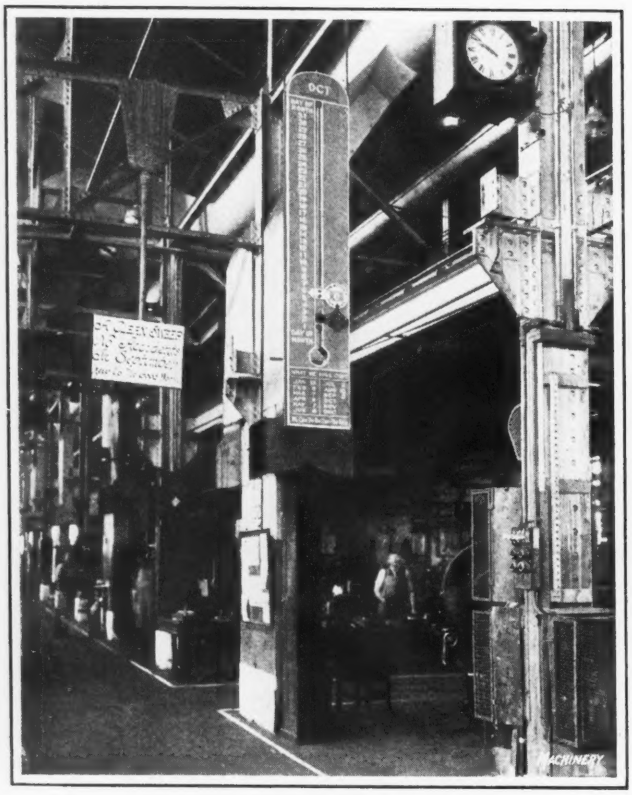


Fig. 11. "Thermometer" used to hold the Interest of the Men in Promotion of Safety

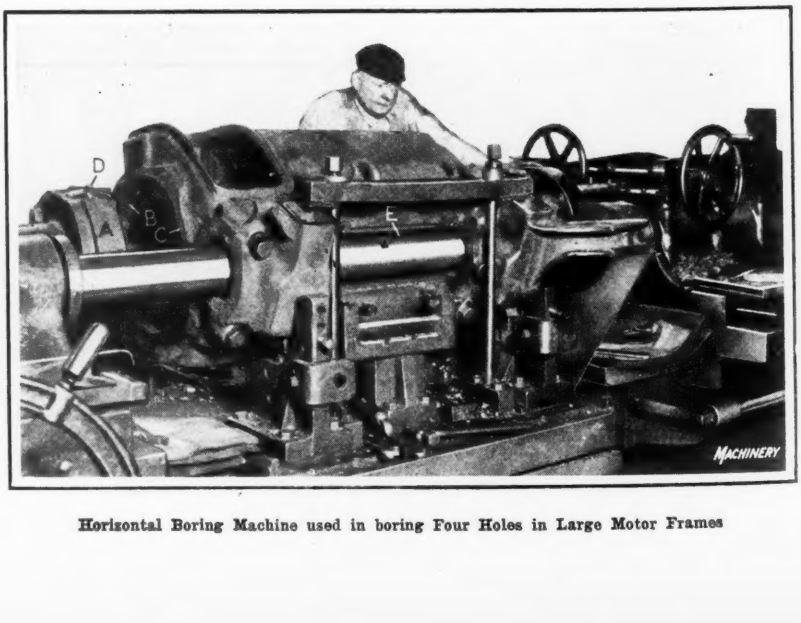
operation of a press ram when the device was between the dies, and show how the operator has been saved from a serious injury.

Interest in the promotion of safety is also maintained through the use of the "thermometer" seen in Fig. 11, which is placed in a conspicuous position in the shop. The marker is moved upward each day until the end of the month, and to this marker is attached a tag giving the number of accidents that have occurred during the month up to the day indicated. At the lower end of the board are shown the number of accidents that have occurred during each of the preceding months of the same year. The example illustrated shows that in the month of September, 1925, there were no accidents at all. This gave the opportunity of hanging up the broom shown at the left of the thermometer, with the very appropriate sign.

* * *

BORING LARGE MOTOR FRAMES

A four-spindle horizontal boring machine is employed in the plant of the Westinghouse Electric & Mfg. Co., at East Pittsburg, Pa., for boring large motor frames to receive the armature and axle. The accompanying illustration shows a typical example. On each of two opposing spindles there is mounted a 16-inch cutter-head, one of which may be seen at *A*. These cutter-heads contain adjustable tool bits. Before starting the boring of surface *B* at either end of the work, the cutter-heads are used for facing surface *C*. This is accomplished by adjusting the tool bit to the approximate diameter of the hole, advancing the head to bring the cutter in line with the surface to be machined, and then feeding the tool bit radially outward at each revolution of the head. The expansion of the tool is obtained through starwheel *D* which strikes a vertical bar at each revolution of the head, and is thus caused to rotate one-sixth of a revolution. This movement, in turn, actuates a feed-screw which imparts an outward feed of 1/32 inch to the tool.



Horizontal Boring Machine used in boring Four Holes in Large Motor Frames

When the facing step has been completed on both ends of the casting, the tool bit of the two heads *A* is adjusted to the proper radius for boring holes *B*. The hole in one end of the casting is bored to 20 3/4 inches, and the other, to 18 inches. Bar *E* carries cutters for boring the motor frame to a diameter of 8 inches at both ends to receive the axle. The bar is driven at the headstock end, and simply piloted in the tailstock.

* * *

ARTIFICIAL LEATHER IN MACHINE SHOPS

By E. T. ELLIS

There are various applications of artificial leather in machine construction. Washers of one kind or another may be made from artificial leather. Experience has shown that it can be punched out into the required shapes quite as easily as natural leather, but it has the advantage over the latter that its life is generally longer.

Machine clutches can be constructed of artificial leather. Although it is commonly believed that the size of clutches made from this material must be limited, owing to the fact that artificial leather is made from waste materials, this is not the case, as if properly prepared, it is equal to the best hide leather in strength, and has the advantage over the latter of not heating up quite so readily. Another application for artificial leather is its use in protecting or covering handles of machine levers. Although these may be in constant use, the material shows very little wear after many months. Handle coverings prepared from artificial leather are also more easily renewed than those prepared from the natural leather.

Artificial leather can be employed as an insulating material in electric machines. Here it is of importance that the material should be heavily rubberized. Rubberized artificial leather for the preparation of these insulators, in addition to being prepared largely from leather waste of boot and shoe factories, is also prepared from waste rubber.

* * *

MOTOR VEHICLE REGISTRATIONS

On the first of July, 19,579,768 motor vehicles were registered in the United States, a gain of nearly 2,000,000 vehicles since July 1, 1925. Of this total, about 87 per cent were passenger cars and buses, and 13 per cent were trucks. The registrations of both passenger cars and trucks gained slightly over 11 per cent in one year. California led in the number of passenger cars in use, and although it has less than half the population of the state of New York, there are nearly 17,000 more passenger cars in use in that state. The state of New York led in the number of trucks in use, but in this field, California comes a close second. According to *Automotive Industries*, the registration fees collected amounted to over $243,000,000, and $93,500,000 was collected in gasoline taxes.

Notes and Comment on Engineering Topics

Enough wire and cable is turned out yearly by one of the large electric companies to loop the earth and moon thirty-two times, and the earth alone, twenty-five times in addition.

In one of the *Research Narratives* published by the Engineering Foundation, 29 W. 39th St., New York City, it is mentioned that copper was first produced from ores about 5000 years before the Christian era. About this time bronze became known, not by melting copper and tin together, but rather because the ores available contained tin, nickel and small amounts of other metals, and produced alloys harder and stronger than copper. The Bible mentions Tubal Cain as a worker in brass and refers to the alloy in several places. There is reason to believe that not brass but bronze is intended. In the first century Dioscorides makes the earliest unmistakable reference to brass (an alloy of copper and zinc); nevertheless, it was known to the Far East long before. Owing to confusion in names, no approximation of a definite time when brass came into use is possible.

In the last twenty-five years, the American people have increased the investments in means of transportation from 10 1/2 billion dollars to 50 billion dollars, and have increased the annual expenditure for transportation of property and persons from about 1 1/2 billion dollars to nearly 20 billion dollars. At the present time, 25 billion dollars is invested in railroads and equipment and over 6 billion dollars is spent for railroad transportation annually. Approximately 25 billion dollars is invested in automobiles and other motor vehicles and in automobile roads. It is estimated that over 12 billion dollars is spent annually for automobile transportation. These figures were given by Ralph Budd, president of the Great Northern Railway, before a meeting of the American Society of Civil Engineers. They indicate that approximately 25 per cent of the nation's annual income is spent for transportation in one form or another.

By the use of a magnetic device for separating iron and steel from monel turnings, the General Electric plant at Schenectady was able to save approximately $20,000 annually in the disposal of its scrap. Approximately 70 gross tons of mixed metal turnings were scrapped each year, as no method was known of separating the high-value monel from the lower value iron and steel. Mixed metal turnings were sold for an average price of $15 per gross ton, while clean monel metal turnings bring approximately $300 per gross ton.

Many methods had been tried for separating the two kinds of scrap, without success, including the use of magnetism. The magnetic method was not successful, because the monel metal was also picked up by the magnet but, finally, by using a rheostat on the magnetic separator, and reducing the current to a minimum, a point was reached where iron and steel could be picked up and the monel metal dropped. During cold weather, a clean separation is difficult, because of oil congealing on the turnings and holding the two metals together. To overcome this difficulty, the turnings are dried on large steel plates with fires beneath.

A pipe line 22 miles in length, completely welded, has recently been constructed for the city of Vallejo, Calif. This pipe line is of steel plate construction, 24 inches in diameter for 15 miles, and 22 inches in diameter for 7 miles. All seams are electrically welded. The wall thickness of approximately 11 miles of pipe is 5/16 inch, 4 miles, 1/4 inch, and 7 miles, 3/16 inch. The pipe line was built by the Western Pipe & Steel Co., using General Electric welding equipment. The total static head on the pipe varies from 100 to 400 feet, and the entire pipe was tested in the shop at a pressure of 225 pounds. A number of sections were tested at 325 pounds pressure per square inch, and a few at 720 pounds pressure, without leaks developing in the welded seams. The finished 22 miles of pipe was put under final test for forty-eight consecutive hours, the pipe being held under a pressure of 200 pounds per square inch at the lowest point in the line. During the test, the line was continuously patrolled and inspected at all points, but no leakage was discovered. While the line was being filled, only one leak occurred in the straight seam in the entire length. Nineteen girth seams showed leakage out of a total of 8200 girth seams.

A new steel that is suitable for forging and casehardening and still has the machineability of ordinary medium carbon steels has been developed by the Jones & Laughlin Steel Corporation. This steel is known as "Jalcase," and is the result of several years' research and experimental work, carried on to develop a steel that could be heat-treated, and that would combine good forging and casehardening properties with easy machineability. It is believed that this steel may take the place of more costly alloy steels for many purposes. Among the uses to which it has so far been applied successfully are shafts, gears, chain sprockets, disk clutches, steering worms, and camshafts. In one case, it is stated that the machining speed was increased 34 per cent, the feed 45 per cent, and production as a whole, 94 per cent, as compared with the results obtainable with the steel formerly used for the same purpose. It is also stated that upon the completion of 108 pieces on an automatic machine, the tools were still in good condition, whereas formerly the cutting tools had to be reground after turning 50 pieces. The steel formerly used was S. A. E. 1020 steel. In cutting disk clutches, it is stated that 700 pieces of the new steel were cut with one tool, as compared with 150 pieces of S. A. E. 1020 steel.

In making concrete, the amount of mixing water controls the strength to such an extent that specifications have been worked out whereby the strength may be predetermined simply by regulating the amount of water relative to the quantity of cement. This predetermination of concrete strengths through the use of varying amounts of water is known as the "water ratio" method. This method insures uniform strength, regardless of changes in workability or in the sizes of the aggregates. For ordinary work, the proper amount of water to use is the smallest quantity that will give a mixture of good workability. Builders in general should use as dry a mixture as practicable.

Thorough mixing is another important point. Concrete should remain in the mixer for at least a minute, and most State Highway Commissions require at least 1 1/2 minutes for mixing. The speed of mixing is not so important as the time, for materials must be thoroughly blended to form good concrete. Dusty or dirty sand, gravel, or crushed stone aggregates will not make strong concrete. Frequently sand and pebbles must be washed as well as screened to remove clay and organic material. Although concrete should be mixed and placed in the forms as dry as possible, it requires frequent moistening to "cure" it properly. For instance, in highway building, a new concrete road is flooded with water for from ten to fourteen days or is kept moist by a covering of damp earth or straw.

Balancing Flywheels on a Ball

By MERRITT R. WELLS*

WE are all used to seeing circus elephants balancing themselves on a ball, but the idea of balancing flywheels and other similar articles on a ball is believed to be distinctly novel. Truly, "necessity is the mother of invention," and so, about two years ago, when it was suddenly discovered that certain automobile fan assemblies (owing to thicker metal being used for some blades than others) were so far out of balance as to cause trouble, the writer suggested making up a simple adapter fitted with a pointer, by means of which the fan assembly could be hung on a sharp pointed support, as shown at *A* in Fig. 3. It will be seen that the axis of the fan was vertical, and with the center of gravity of the assembly located close to, but just below the point of support, a very sensitive pendulum was obtained. Any unbalance was at once apparent, both as to location and amount.

This scheme worked so well for the fans that when later it became necessary to balance front flywheels, weighing approximately 10 pounds, the same method was tried. It was soon apparent, however, that the weight was too great for the simple pivot support, and the adapter was redesigned so that the load was supported by a steel ball, resting on the hardened and flat end of a central post, as shown by the diagram *B*, Fig. 3. In spite of this crude make-up, and the fact that the ball and anvil were subjected to a rather severe blow each time a flywheel was dropped into place, the device proved a success.

The next most natural step was to consider a similar scheme for balancing rear flywheels, which weigh about 60 pounds. The balancer made for this work is mounted on the drill press table, at the height most convenient for the operator. (See Figs. 1 and 2). By reference to the cross-section,

*Merritt R. Wells attended the Manual Training High School in Indianapolis, and after graduating from Purdue University, superintended construction for the National Bridge Co. and for the Pressed Steel Car Co. Later he went into the gas engine department of the Westinghouse Electric & Mfg. Co., starting on the test floor at ten cents an hour. He was soon transferred to experimental work, and before long was made assistant to the head of the gas engine department. Five years later he became connected with the Columbia and Electric Vehicle Co. of Hartford, Conn., in charge of testing and experimental work. When this company discontinued business, he went with the Mitchell Motor Car Co. of Racine, Wis., having charge of production. A year later he became associated with the Peerless Motor Car Co. of Cleveland, Ohio, where he remained for thirteen years. For more than four years he was research engineer of the Cleveland Automobile Co., much of his time being given to the production end, developing cost-cutting methods, etc. On July 1 he left this company to devote his time to testing "Welco" fan blades on which he holds patents.

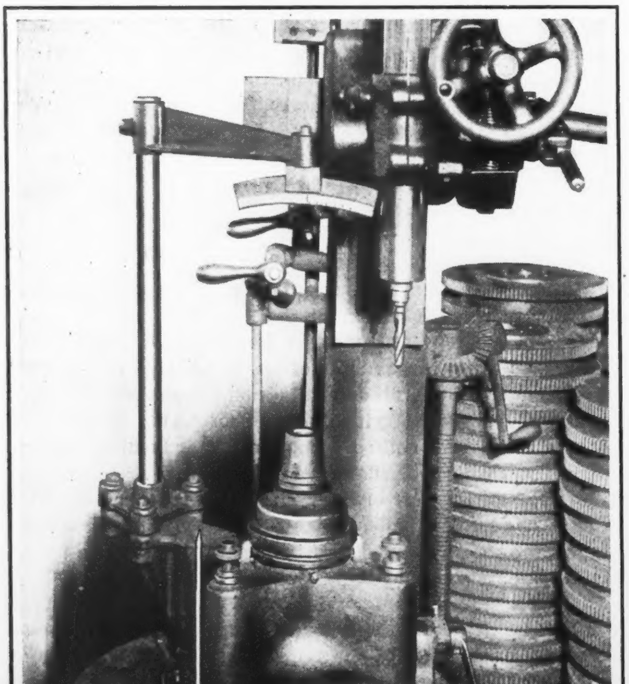


Fig. 1. Ball Type of Balancing Fixture used for Flywheels

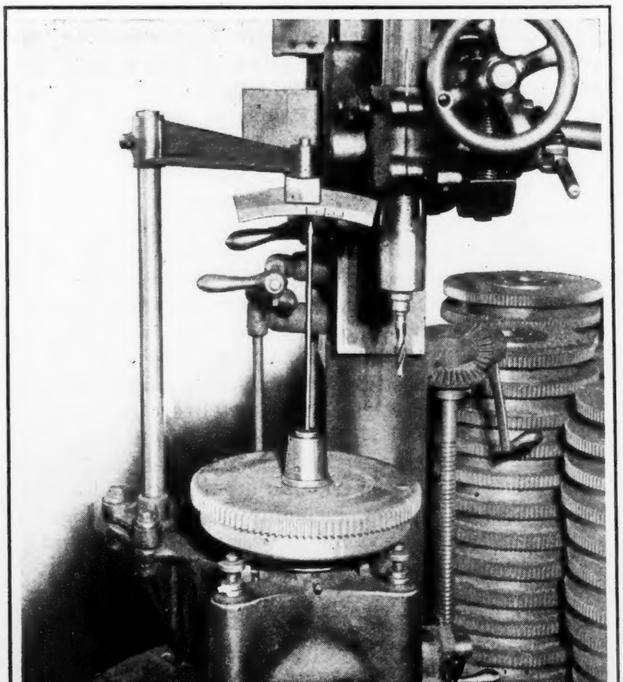


Fig. 2. Flywheel in Position for testing Balance

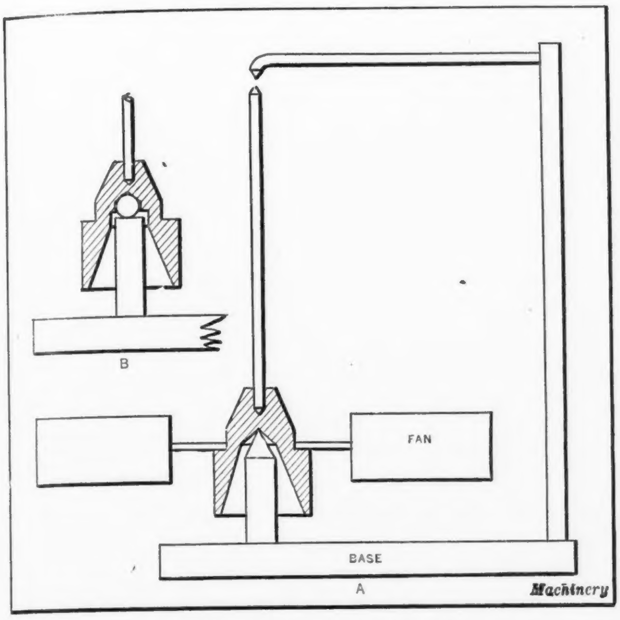


Fig. 3. (A) Pointed Support for checking Balance of Fan; (B) Method of using Ball for Fan Balancing

Fig. 4, it will be clear that the adapter *A*, over which the flywheel is placed, can be raised and lowered by means of the crank *C* and eccentric *E*. In the raised position, the flywheel and adapter are resting on the ball *B*, with their center of gravity slightly below the center of the ball. They are then perfectly free to roll or rock with the ball on the anvil *F* to a position of equilibrium. In the lowered position, the flywheel rests on the three adjustable supports *J* and with the adapter resting on the top of the base, the ball is relieved of all load. In this lowered position, the dogs *D*, enter the groove *G* near the lower edge of the adapter, and thus prevent it from being lifted off when the wheel is being removed.

Method of Checking Balance

The operating procedure is as follows: The operator (not necessarily a skilled mechanic) places the flywheel over the adapter while it is in the lowered position, and inserts the long pointer *P* in the top of the adapter. He next turns crank *C*, together with the eccentric *E*, thus raising the central plunger *L*. The first portion of the movement releases dogs *D*, and further movement lifts the anvil *F*, together with ball *B*, until it is in contact with adapter socket *H*, and finally supports the flywheel. The flywheel, if out of balance, now tips to one side a certain amount, and the pointer *P* at once indicates where the heavy portion is. The wheel is then rotated until the pointer is directly under the scale *S*, at which time the heavy portion will be under the drill. Pointer *P* is now swung in a circle around the zero on the scale, and when it is at rest, it will indicate directly on the scale *S*, the depth of the hole required to remove the excess weight.

Having determined this, crank *C* is swung to lower the ball and leave the wheel resting on the three supports *J*, one of which is directly under the drill. The drill is next fed down the predetermined distance, according to the scale on the drill spindle. The chips are blown off with a compressed air nozzle, after which the ball is again raised and the balance rechecked although this is not necessary. The time required from floor to floor averages about one minute, or less than the time required to describe the operation. The average time by the old method was approximately four or five minutes. By the new method, the daily checks after this balancing operation, show an average result of close to 1 inch-ounce out of balance. This is a very small amount, as it is equivalent to the weight of a five-cent piece at a radius of 6 inches, as seen in Fig. 2.

Referring to the details, it may be noted that the anvil *F*, which is very hard, is a slip fit in the plunger *L*, and rests on a lump of rubber *R*. This protects the point contact between the anvil and ball, by cushioning the blow when the plunger is raised quickly, and the adapter, together with the flywheel, is raised by the ball. It may be pointed out that the ball is free to shift its position each time it is lowered, and thus presents new points of contact.

As an indication of how the contact surfaces withstand usage, after more than seven months use in regular production in the Cleveland Automobile Co.'s works, the pointer was recently tipped to 1 inch away from the zero point, with the wheel in position for balancing, and then released, thus starting the wheel rocking. The friction was so low that the rocking did not die out for more than ten minutes. The ball *B* has 1/32 inch clearance all around it, which is sufficient to prevent contact except at extreme rocking or tipping. It is in order to insure that there will be no friction from contact at the sides of the ball that the operator first swings the pointer around the zero point, thus centering the ball.

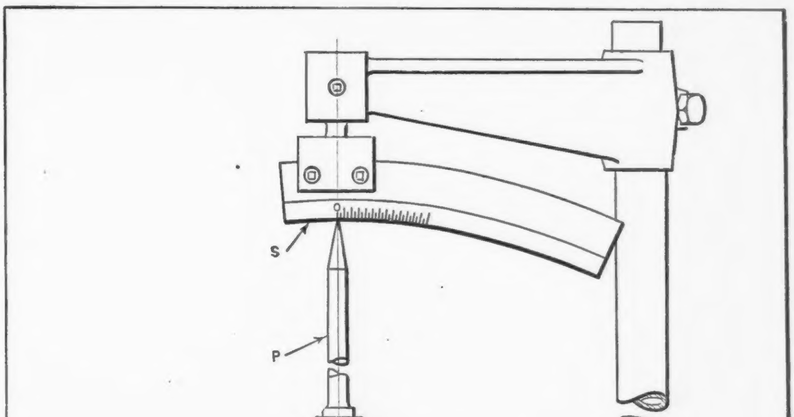


Fig. 4. Sectional View of Flywheel Balancing Fixture showing Location of Ball

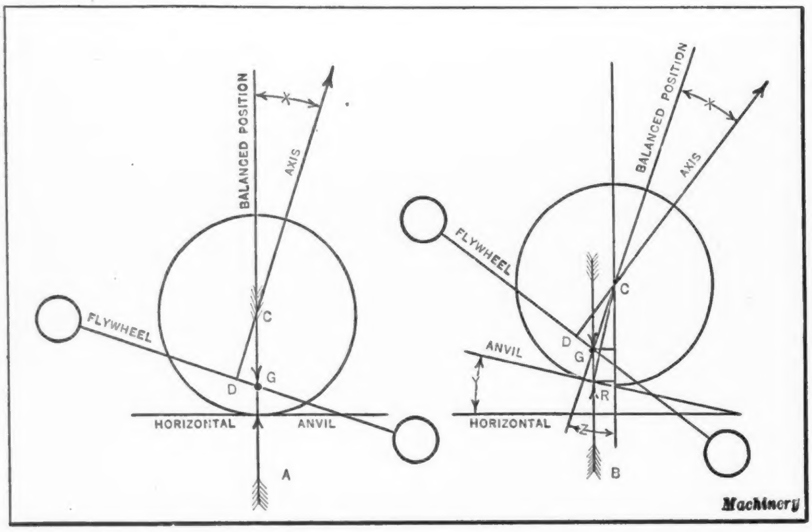


Fig. 5. Diagrams used to illustrate Principle of Ball Method of Balancing

The position of ball *B* with respect to the adapter can be adjusted by means of screw *K*, thus locating the center of the ball as near the center of gravity as desired, in order to obtain the degree of sensitiveness required. It has been so set that the weight of one cent placed at the rim of the flywheel, swung the pointer more than 1 inch on the scale. This was too sensitive an adjustment for practical use, as most wheels would tip too far off the scale before being balanced. It might be noted that there is very little chance for dirt to get between the ball and the anvil.

Scale *S* is made reversible, as well as adjustable, so that it may have more than one set of graduations, each calibrated to suit a different design of flywheel. A separate adapter is advisable for each design of wheel, owing to the difference in diameter of the holes, and to the fact that the centers of gravity are at different locations.

Analysis of Balancing Principle

For those who are interested in an analysis of the forces involved, let us consider all the weight of the flywheel, adapter, and other rocking parts, as concentrated at the center of gravity *G*, diagram *A*, Fig. 5, in a plane that is perpendicular to the axis of the flywheel and at a distance *CD* below the ball center. Also assume that the wheel is not in balance, and hence that *G* is not on the axis, but a distance *DG* away from it. The only forces acting are due to gravity, and hence for equilibrium, we have a force equal to the weight of the rocking parts acting down through the center of gravity *G*. An equal and opposite force must act through the point of support (at the contact between the ball and anvil) and in line with the force *G*. If the surface of the anvil is horizontal, it is evident that these forces also act through the center of the ball. The pointer or axis, therefore, comes to rest at the angle *X*, whose tangent is $\frac{DG}{CD}$ which, it will be seen, is independent of the weight *G*.

If the anvil is not level, as shown by diagram *B*, Fig. 5, the ball must tip or roll down hill until, instead of point *G* being on the radius *CR* leading to the point of contact *R*, it will be vertically above the latter. This is true when $CR \sin Y = CG \sin Z$. Hence the angle at which the pointer or axis settles will be altered by the angle *Z*, as a result of the anvil not being level. This tip may not happen to be in the same direction as that due to unbalance, or to *G* not being on the axis. It may, therefore, either increase or decrease the total tip, but the main thing to be noted is that this angle *Z* is constant as long as the distance from *G* to the center of the ball remains unchanged. Hence, it only alters the zero setting (which is adjustable), and can be neglected.

Referring again to the angle *X* whose tangent is $\frac{DG}{CD}$, we see that if we assume point *G* to always lie in a plane perpendicular to the axis, and at a constant distance *CD* below the ball center, then the tangent of the angle *X* or the inclination due to unbalance, varies directly as the distance *DG*. For small angles of less than 10 degrees, the tangent may be considered as directly proportional to the angle itself; hence the inclination varies as the distance between the axis and the center of gravity *G*. For example, with a balanced flywheel weighing 50 pounds, an addition of one ounce at 1 inch radius means 1 inch-ounce out of balance, and only shifts the center of gravity away from the axis a distance *DG* equal to 0.00125 inch; however, if the ball is adjusted so that the distance *CD* is likewise small, as, for instance, 1/16 inch, then the tangent $\frac{DG}{CD}$ equals $\frac{0.00125}{0.0625}$ or 0.02, which is the tangent of more than 1 degree, and means that a pointer 20 inches long will swing more than 1/3 inch along the scale.

Owing to this sensitiveness to a very slight shift between the center of gravity and the axis, it is at once evident that extreme care must be taken in machining the adapter so as to locate the ball and pointer exactly on the axis of the wheel. The clearance between the flywheel and the pilot of the adapter becomes very important, as it allows a shift which may easily cause a tip equal to an unbalance of 1 inch-ounce; in fact, it becomes the predominating factor in determining the limits of accuracy to which the wheels may be balanced. The crankshafts used with these flywheels are given a running test on a Gisholt balancing machine.

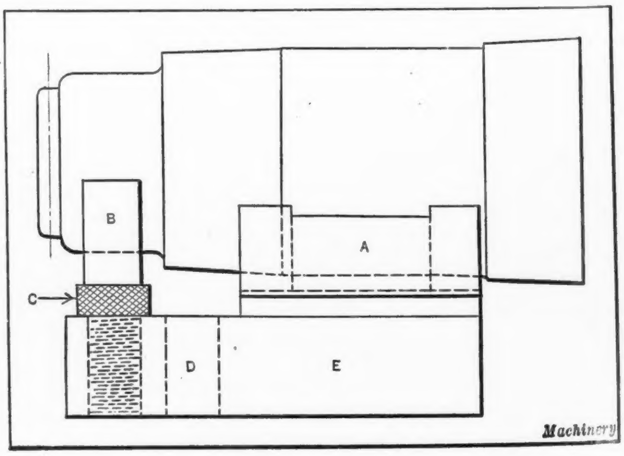
* * *

V-BLOCK FOR DRILLING WRIST-PINS

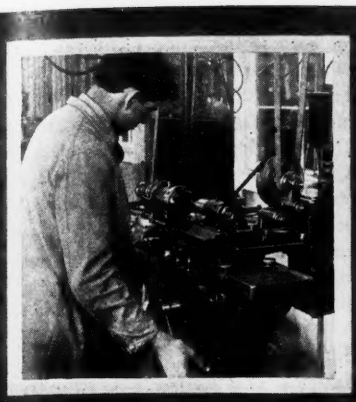
By E. A. MURRAY, Shop Superintendent, Chesapeake & Ohio Railway Co.

The drilling of cotter-pin holes in wrist-pins and knuckle-pins is an awkward operation, due to the fact that the holes are so close to the end of the pin. To overcome this difficulty, a special V-block was made, as shown in the illustration. The body of the pin to be drilled rests in the main V-block *A*, and the threaded portion has a separate V-shaped support *B*. The latter may be adjusted vertically by turning nut *C* to suit different diameters.

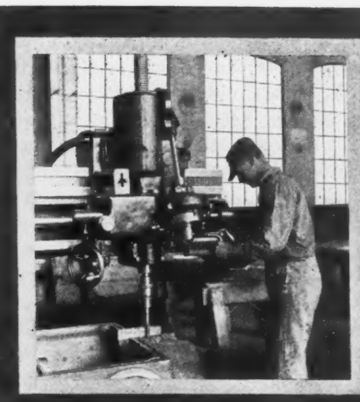
In drilling knuckle-pins that have the threaded portion closer to the body of the pin, support *B* is placed in hole *D*. The base *E* is 8 1/4 inches long and 3 1/2 inches wide, and the V-shaped sections of supports *A* and *B* have an included angle of 90 degrees. This design was suggested by R. G. Perkins of the Huntington Shops of the Chesapeake and Ohio Railway Co.



Special V-block for holding Wrist-pins and Knuckle-pins while drilling Cotter-pin Holes



Letters on Practical Subjects



EQUIPMENT FOR CUTTING ACCURATE THREADS

The equipment shown in the accompanying illustrations is employed for cutting screw threads that are required to be very accurate as to form, lead, and finish. It is adapted for threading operations on such tools as hobs, laps, and special formed tools used in the manufacture of chasers for die-heads. In Fig. 1 is shown a special fixture for grinding the threading tool accurately to shape. In this case, the fixture is used on a common tool-room grinder. It consists of a base *A* which supports the yoke *B* mounted on cylindrical bearings. At its middle point, the yoke drops below the center or axial line, and has a finished surface for receiving and locating the cutter to be ground. A cutter *D* is shown in position for grinding, and a finished cutter *E* may be seen resting on the bed of the fixture.

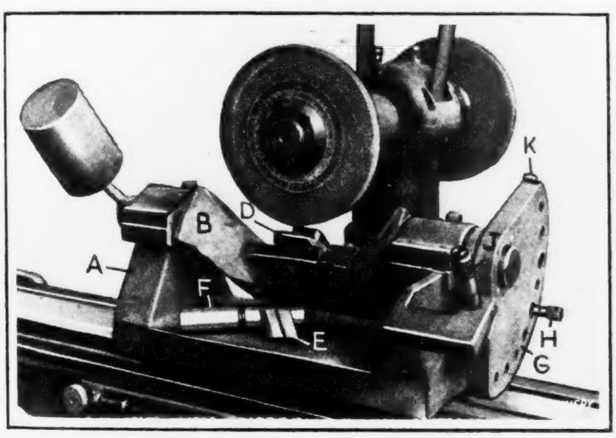


Fig. 1. Fixture for grinding Threading Tool

The grooved cylindrical piece *F* is a special setting gage used in the lathe for setting the threading tool in the correct angular position. By reversing the grooved piece, a check on the accuracy of the tool setting and the tool form is obtained. At the right-hand end of the fixture is a quadrant *G* having a series of holes, in one of which a hardened plug *H* is inserted. The holes are for different angular settings of the yoke for various forms of tools. Two micrometer heads are provided, one of which is shown at *J* and the other at *K*. The micrometers are used for the final adjustment after the plug *H* has been put in place.

It should be noted that the cutter *E* has a groove midway of its width, which runs lengthwise. This groove is used for clamping the cutter in the fixture while grinding, and for holding it in the lathe tool-block. The tool or cutter is made slightly diamond-shaped in order to give top rake or clearance. The bottom edge of the cutter has the same angle as the top, that is, the top and bottom edges are parallel. This facilitates holding the cutter on a magnetic chuck, or rapping it down in place on a plain chuck until it rests on the chuck bottom, in order to permit the accurate grinding

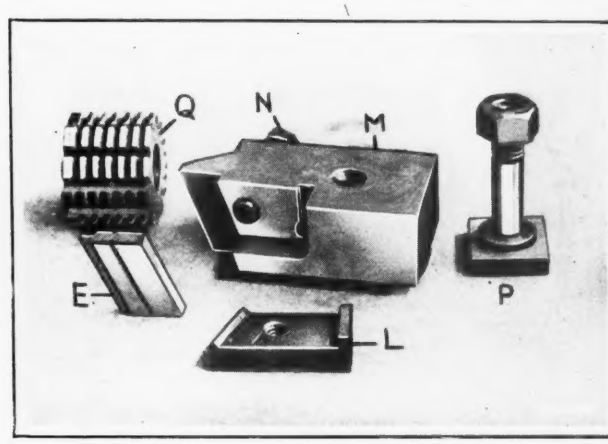


Fig. 2. Finished Threading Hob and Disassembled Tool-holder

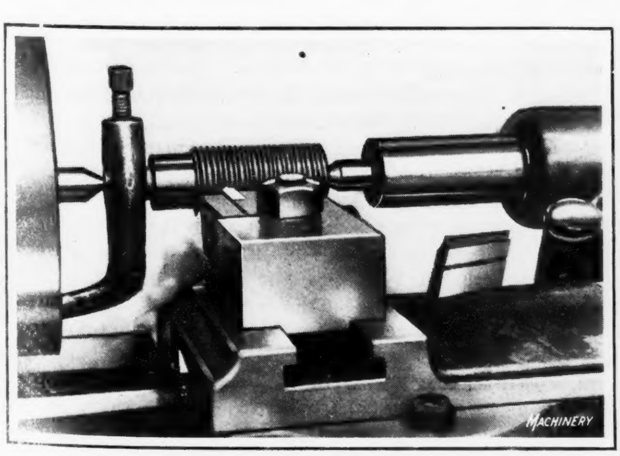


Fig. 3. Cutting an External Thread

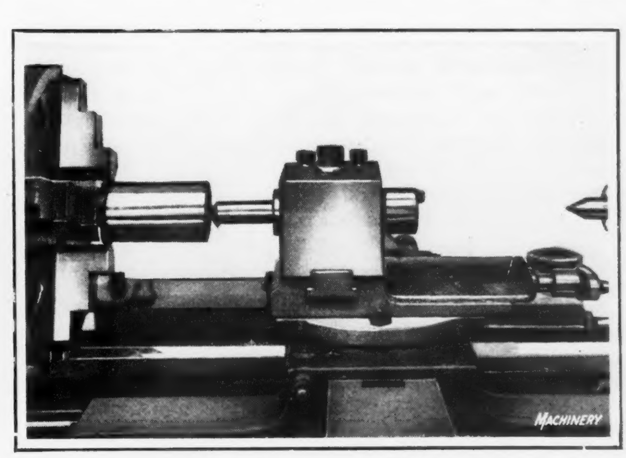


Fig. 4. Cutting an Internal Thread

of the top or cutting threads. To obtain a suitable finish, the cutter is lapped on a lapping plate, care being taken to preserve the exact form produced by grinding.

The cutter-holder used in the lathe is shown disassembled in Fig. 2. The cutter clamp is shown at *L*, the finished cutter at *E*, the main block for supporting the cutter at *M*, the clamping screw at *N*, and the main clamping bolt for holding the block to the lathe at *P*. A hob which has been threaded with a tool like the one at *E* is shown at *Q*. This hob is used for forming chasers employed in die-heads.

In Fig. 3 is shown the cutter-holder with the cutter at work. It may be mentioned here that the cutter is always at the correct height relative to the work when it is set flush with the top of the holder. Also, the holder is positioned in the compound rest by a close-fitting tongue, which is part of the cutter-holder. This construction eliminates all side play. The holder is made to line up accurately when the compound rest is at the zero setting, or in case there is any slight discrepancy, a line is scribed on the slide to obtain the required setting. It is preferable to use the compound slide as shown, because this permits the tool to be adjusted or accurately positioned longitudinally.

In Fig. 4 is shown a set-up for cutting an internal thread. The cutter-holder is made to fit the compound slide, a hole being bored in the holder while it is mounted in place, by a boring tool held in the lathe spindle, thus insuring correct tool height. Cutter-bars with round or cylindrical shanks, having accurately ground thread forms of the required shape, are used. Except in cases of very quick leads, the cutters do not require any clearance for the helix angle, provided the diameter of the cutter is not too large for the diameter of the thread.

Springfield, Vt. O. S. Marshall

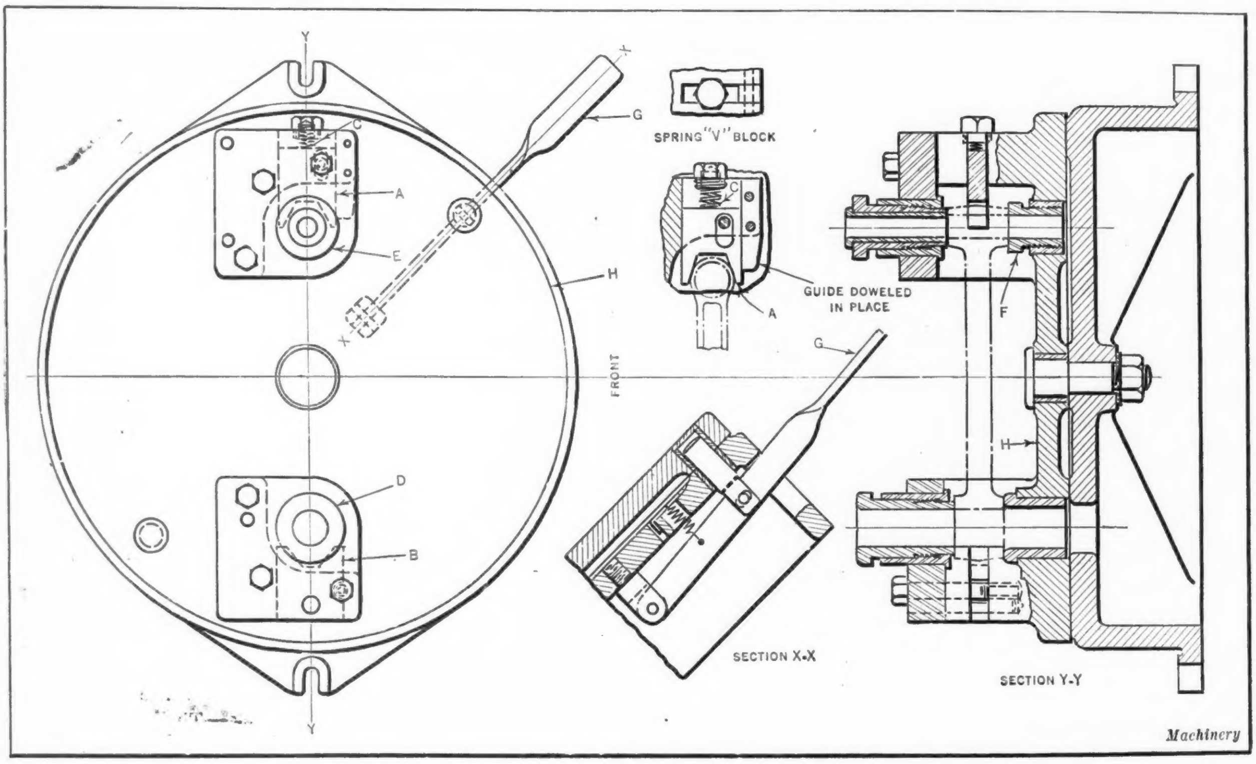
BORING FIXTURE FOR CONNECTING-ROD

In June Machinery, on page 813, was published a description of a fixture for drilling, boring, and reaming the wrist-pin and crankpin holes in a connecting-rod. In the present article, changes in the original design are suggested, which could be made at very little additional cost and would greatly increase the efficiency of the fixture. The improved fixture can be loaded and unloaded at a saving of fully two-thirds of the time required with the fixture previously described.

The chief differences in the fixtures are in the details of design, as the principle of both is the same. The refinements in the details, however, which can be made at but little additional expense, make a great difference in the production time. The two most important changes shown in the accompanying illustration are the spring-operated V-block *A* and the index-pin operated by lever *G*. To index the fixture, the operator simply pushes down on the index-handle *G* with his right hand, and with his left hand grasps the top of the fixture and swings it around into position for the next operation. The operator can remove his hand from the handle *G* as soon as the indexing movement has begun, as the plug shown in the sectional view *X–X* will automatically snap into position in the index-hole bushing.

It should be noted that the end of the index-pin is not chamfered, but is slightly rounded. A great many designers specify a chamfer of 30 or 45 degrees on the end of index-plugs. While an indexing plug chamfered in this manner may prove satisfactory for a while, it is not, in the writer's opinion, desirable for a spring-actuated plug. A plug that will so readily snap into place encourages the operator to spin the index-plate around in an effort to save time. The shock of the blow caused by the sudden stopping of the index-plate will soon cause a loose fit and result in inaccuracy in the location of the index-plate. With the type of plug shown in the accompanying illustration, the operator must move the plate slowly in order to permit the index-plug to enter the bushing.

When the fixture is in use, the operator places the end of the connecting-rod in the V-notch in block *A*, and pushes the rod back, causing the block to compress spring *C* sufficiently to permit the large end of the rod to be slipped into position in the V-block *B*. This method of loading the work in the fixture obviously requires much less time than would be the case with a screw-operated V-block. The holding power of the spring-actuated V-block might not, at first thought, be considered sufficient to meet the requirements, but a careful consideration of the conditions should remove any doubts on this point. The force exerted by the cutting action of the drill, which tends to swing the rod around the center of the tool must overcome the pressure exerted by the clamping bushing and also the resistance of the 20- to 30-pound spring *C*. The clamping bushing alone is capable of holding the connecting-rod after it has been located by the spring V-block.



Indexing Fixture for Use in drilling, boring, and reaming Connecting-rods

If, however, the designer does not care to use the spring type of V-block, a positive clamping cam may be used in place of the spring. The cam may be operated by a short handle, and is as positive in its action as a clamping screw. It can be designed to allow for any reasonable variation in the forging. When the fixture is in use, the operator, standing in the position marked front in the illustration, loads the connecting-rod into the fixture by placing the small end in the spring-actuated V-block *A*, then forcing this block back until the large end of the connecting-rod swings into place in the fixed V-block *B*. If the V-block *A* is cam-operated, the operator simply places the rod in position and pulls the cam handle around far enough to securely clamp the work in place. After the rod is located, the bushing *D* is screwed down against the work. The supporting bushing *F* is then adjusted until it is in contact with the base of the connecting-rod boss, after which the second clamping bushing *E* is screwed down tight, making the rod ready for the first drilling operation.

After completing the first hole, the operator pushes down the index-handle *G*, starts the indexing movement of plate *H*, lets go the handle *G*, and completes the indexing movement; he then changes tools in the quick-acting drill chuck. When the second hole has been completed, the fixture is indexed around to bring the open side into position for unloading the work. It may be well to mention here that if the bosses are to be finished on their face—either disk-ground or straddle-milled—these operations should be performed previous to drilling. In that case, the screw bushing *F* could be replaced by a fixed bushing, as it would not be necessary to adjust it for each rod.

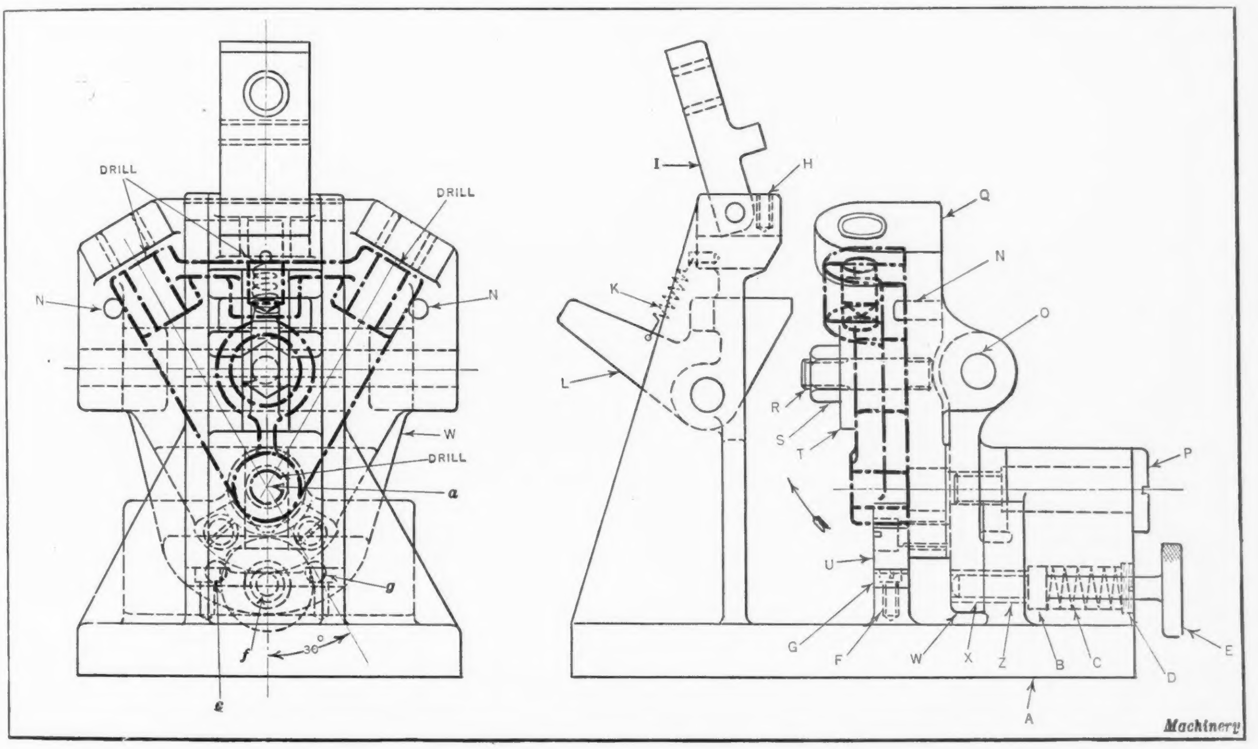
Syracuse, N. Y. E. P. Stoutenger

INDEXING AND PIVOTING TYPE OF DRILL JIG

The drill jig shown in the accompanying illustration is employed in drilling four 3/4-inch holes in the cast-iron swivel pulley bracket indicated by dot-and-dash lines. Three of the four holes indicated in the bracket are required to be spaced 30 degrees apart, with their center lines intersecting at point *a*. The center line of the fourth hole also passes through the point of intersection *a*, but is at right angles to the center lines of the other holes. Previous to the installation of the new jig, a box-type jig was used, which was more or less cumbersome and required the workman to make a great many motions in order to complete the drilling operation. The new jig lessened the amount of manual labor required and increased the production rate approximately 25 per cent.

Referring to the illustration, it will be noted that the base *A* of the jig is provided with brackets at each end which are cast integral with the base. The bracket at the right-hand side of the base provides a bearing for the stud *P*, which is threaded to fit the swivel member *W*. Three index-holes *e*, *f*, and *g* and the index-pin *E* provide a means for properly positioning the work to drill the three holes that are spaced 30 degrees apart. In the illustration, the index-pin *E*, which slides in the hardened steel bushing *Z*, is shown in place in the hardened steel bushing *X* of the index-hole *f*. The spring *C*, which is retained by the threaded plug *D*, causes the plunger or index-pin *E* to automatically drop into the index-holes.

The boss at the lower end of the piece of work is located in a hardened steel V-block *U*. The lower surface of this block is machined to a radius having point *a* as a center. This curved surface rides or rotates on the flat pad *G*, so that the work is rigidly supported while drilling any one of the three angular holes. The upper part of the work is located under the three drill bushings by the two pins *N*. The work is strapped to the member *Q* by means of stud *R*, washer *T*, and nut *S*. Previous to being clamped in the jig, the work is machined on the surface that makes contact with the face of the member *Q*.



Jig used for drilling Swivel Bracket

In the illustration, the work is shown in position for drilling the central hole, the other two angular holes having already been drilled by indexing the swiveling member *W*, as previously explained. The next step after drilling the central hole is to swing the holder *Q* up in the direction indicated by the arrow, pivoting it about the pin *O*. As the holder is swung upward, the V-block *U* comes in contact with the latch *L*, forcing it backward against the tension of spring *K*. When block *U* passes the end of latch *L*, the latch snaps back into position and serves as a support for member *Q*. The leaf *I* is then dropped down into contact with block *U*, and fastened in place by a quarter-turn screw—not shown—inserted in the tapped hole *H*. The work is now in position for drilling the hole at *a*.

It should be noted that the pin *O* is so positioned that when the swiveling member *Q* is swung up into place, the center of the hole to be drilled is in line with the center line of the drill spindle. In other words, all four holes are drilled in the part without moving or sliding the jig on the table of the drilling machine.

Bridgeport, Conn. J. E. FENNO

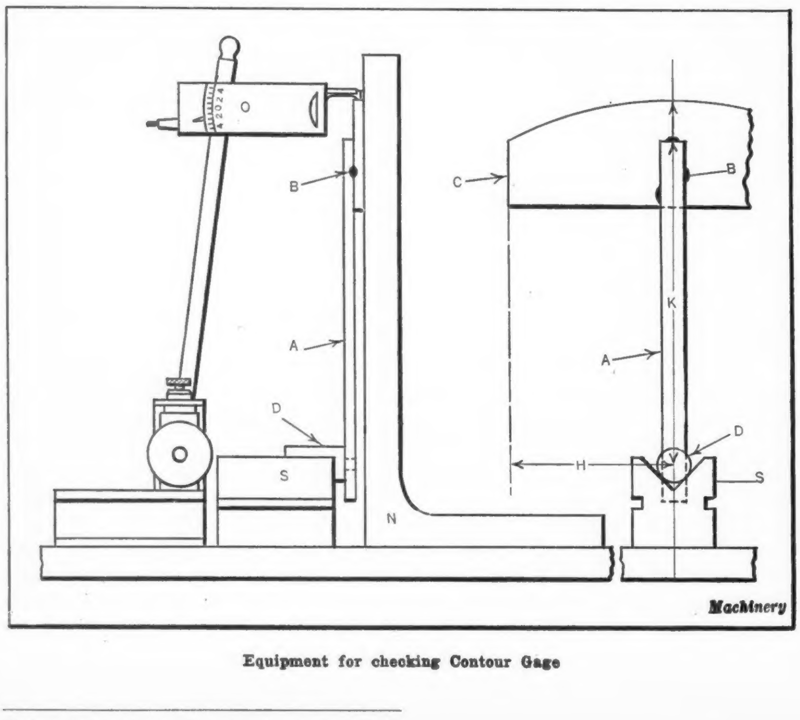
CHECKING CONTOUR GAGES

The method of checking contour gages described in this article was developed by the writer with the object of eliminating involved mathematical calculations, such as are ordinarily required in checking contour gages having profiles formed by a series of arcs. The simplicity of this method will doubtless appeal to toolmakers in general, and especially to those who have a limited knowledge of advanced mathematics.

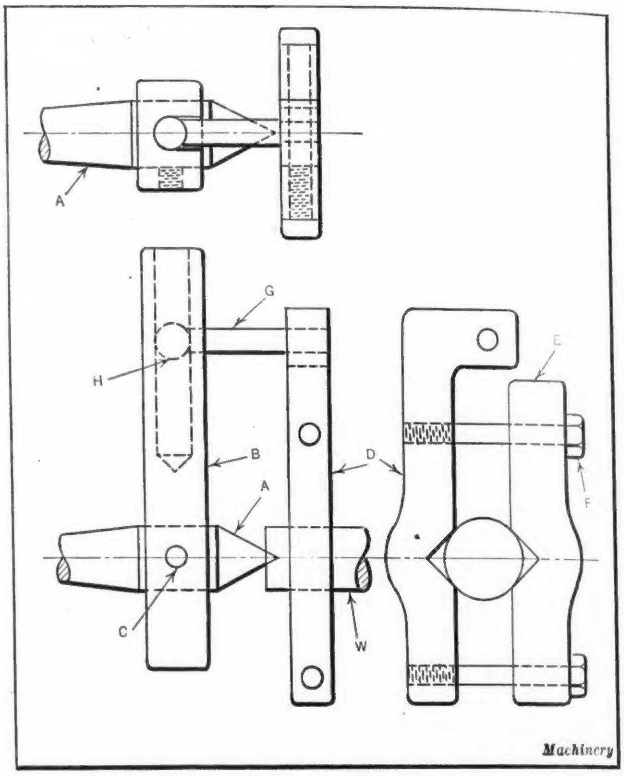
As contour gages are generally produced by scribing or laying out the profile and then filing the metal to the scribed lines, it is necessary to check up the entire contour in order to obtain a gage of the required accuracy. Briefly, the equipment required consists of a parallel *A*, with a piece of drill rod *D* at one end, the other end being soldered to the gage at *B*, if the gage has been hardened and cannot be drilled for screws. The center of plug *D* must be in the center of the arc to be checked, and at a given distance from the edge *C* of the gage. The required dimensions for thus positioning the plug *D* are indicated at *K* and *H* in the illustration, and are given on the detailed drawing of the gage. A depth gage and surface plate can readily be employed to obtain the required setting of the parallel *A* on the gage, and clamps may be used to hold the two members in place while they are being soldered.

When the contour is being gaged, the plug *D* rests in a V-block *S*, and a gage is placed against angle-plate *N*, after which the indicator *O* is set to the zero point and the plug revolved in the V-block *S*. The indicator is employed in this manner to check the contour of the gage for the entire length of the arc being tested. Any high or low spots will be clearly located by the indicator. After checking the contour determined by one arc, the parallel *A* is removed and secured in the proper position for checking the adjacent arc. In the case of a reverse curve, the parallel will, of course, be located on the opposite side of the gage, and the indicator *O* will then make contact on the lower instead of the top side of the gage; otherwise, the procedure followed in checking a reverse curve is the same as described.

Philadelphia, Pa. CHARLES KUGLER



Equipment for checking Contour Gage



Dog designed to eliminate Strain on Work

COMPENSATING DOG FOR DIVIDING HEAD

In milling work between centers, using a dividing head, an error may creep in no matter how carefully the dividing head and the tailstock are trued up. When the work is put between the centers and the dog tightened, the latter operation may cause trouble, particularly if a slender arbor and an ordinary lathe dog are used.

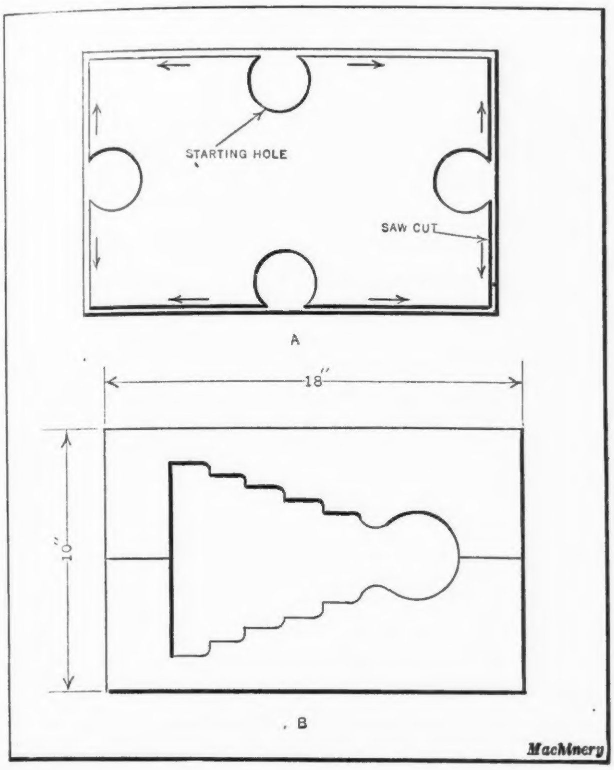
In nine out of ten cases, the dog is twisted when tightened up, thereby producing a strain on the arbor or the work. If an indicator is used after the dog is tightened, the work will often be found to run out of true, and if this is not corrected, the work will, of course, be out of line and unsatisfactory. This trouble may be eliminated by employing a dog like the one shown in the illustration. The method of applying the dog is shown by the view in the lower left-hand corner.

The lathe center is shown at *A* with the driving bar *B* secured to it by pin *C*. At *D* is the driving member, which is secured to the work *W* by tightening the bolts *F* that actuate clamp *E*. The driving pin *G*, which is a drive fit in arm *D*, has a ball *H* turned on its outer end, which fits in a hole in the member *B*. The slot in the front face of member *B* is made wide enough to clear the pin *G*. With this arrangement, it is obvious that no twisting or bending movement can be imposed on the work when tightening the clamping member *E*.

Newark, N. J. JACOB S. SMIT

CUTTING OPENINGS IN DIES

The writer read with interest the article entitled "Cutting Openings in Dies," on page 885 of July MACHINERY. At the plant of the Oliver Instrument Co., Adrian, Mich., we have long advocated this method of removing the surplus metal from dies, and we may be able to make some suggestions regarding this procedure. In sawing out the die blank indicated at *A* in the accompanying illustration, we would suggest



Die Opening cut on Power Hacksaw

drilling the holes in the center of each side instead of in the corners as shown in the view accompanying the previous article. When the saw has reached the end of its cut on each side, as indicated at *A* in the accompanying illustration, and the metal has been removed, the four corners will be square, and the hand finishing greatly simplified.

We cannot entirely agree with the statement in the previous article regarding finish-filing the die and the accuracy of the sawing operation. Dies made by this method may be sawed within 1/64 inch of the finish line, and may even be sawed to the clearance angle, so that the time required for filing is greatly reduced. The use of the power hacksaw is not confined to dies having straight sides, but is applicable to dies of irregular shape with curved outlines, and also to those having long narrow slots. It can be used in cutting out any shape in flat metal under 1 inch in thickness, including stripper plates, punch pads, gages, templets, and similar parts that are ordinarily cut out roughly by drilling holes around the outline. In our plant we have developed a machine for sawing this class of work, and have been informed that the saving resulting from its use has been as much as 66 per cent.

The writer recently witnessed a demonstration that indicated the time-saving possibilities of the power hacksaw on die work. The work consisted of sawing out a stripper plate from steel, 3/8 inch thick, having an irregular outline about 18 inches in length. The foreman estimated that about 4 1/2 hours would be required to do the work. The work was then taken to the power hacksaw, and completely finished in twenty-four minutes.

The job of sawing out the piece indicated at *B* in the accompanying illustration is typical of the work regularly handled at our plant. The material consists of four plates of cold-rolled steel, 10 by 18 inches, with a total thickness of 11/16 inch. The length of the outline is 50 inches, and the time required to saw out the work on the outline was four hours and twenty minutes. It is safe to say that a toolmaker would not progress very far in laying out and drilling a row of holes in the same length of time. The comparatively smooth surface left by the saw also permits the work to be finished in a fraction of the time required when the surplus metal is removed by drilling.

Adrian, Mich. E. C. OLIVER

MAGNETIC T-SQUARE

In making mechanical drawings, care must be taken to keep the head of the T-square pressed tightly against the left-hand edge of the drawing-board. This requires constant attention on the part of the draftsman. A T-square will hold its proper position without any attention if it is fitted with two U-shaped magnets which are in contact with a smooth, straight steel or iron strip fixed to the left-hand edge of the board.

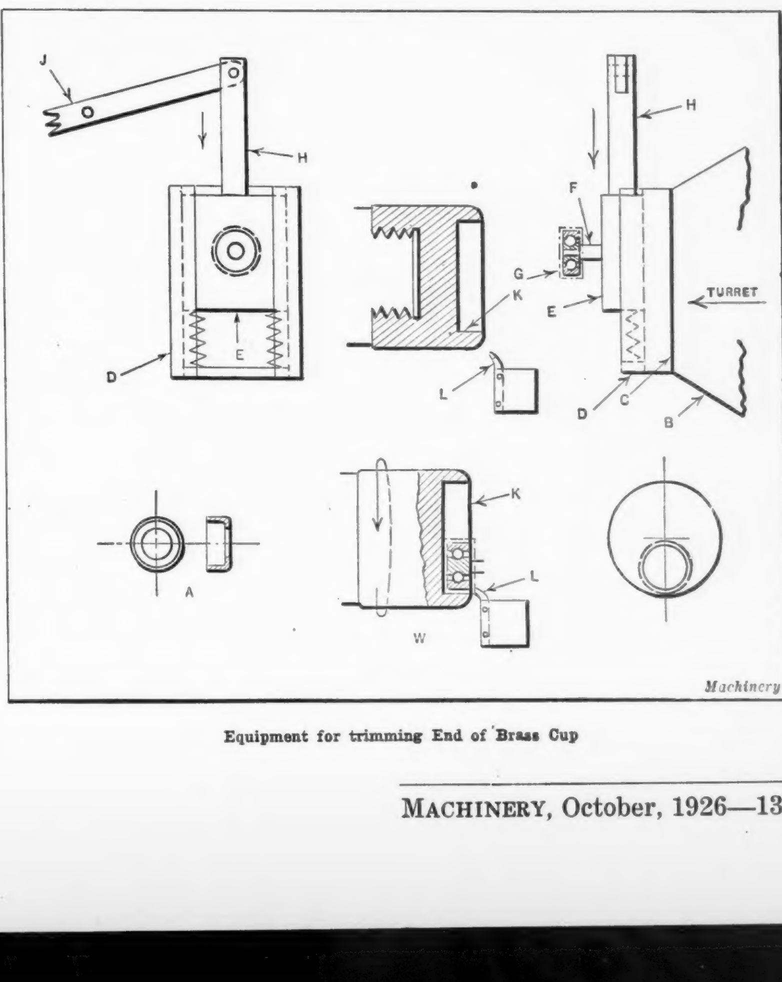
One magnet could be used, but two hold the T-square more securely. Besides holding the head of the T-square against the guiding strip, the magnets serve to prevent it from sliding down or dropping to the floor when the drawing-board is tilted at a sharp angle.

Everett, Mass. DEXTER W. ALLIS

TRIMMING ENDS OF BRASS CUPS

The brass cup shown at *A* in the accompanying illustration is blanked and drawn in one operation in a special press die, after which the rough edge is trimmed. The equipment used for the trimming operation is shown in the illustration. To face *C* of the turret *B* of an old hand screw machine, was secured a bracket *D* on which a slide *E* was fastened. The short shaft *F* was made a drive fit in a hole in slide *E*, and the ball bearing *G* pressed on the end of the shaft. The ball bearing is of the standard radial type with the outer race ground to a slip fit in the shell to be trimmed. A yoke *H* was attached to the slide *E*, which was operated by a foot-treadle *J*.

In operating the trimming device, the workman simply pushes a shell over the ball bearing *G* and brings the turret *B* forward against the locating stop, after which he depresses the foot-treadle, bringing the shell into contact with the inner surface of the hardened steel sleeve *K*, as indicated in the view at *W*. Sleeve *K* is mounted on the lathe spindle, and causes the shell on the ball bearing to revolve when con-



Equipment for trimming End of Brass Cup

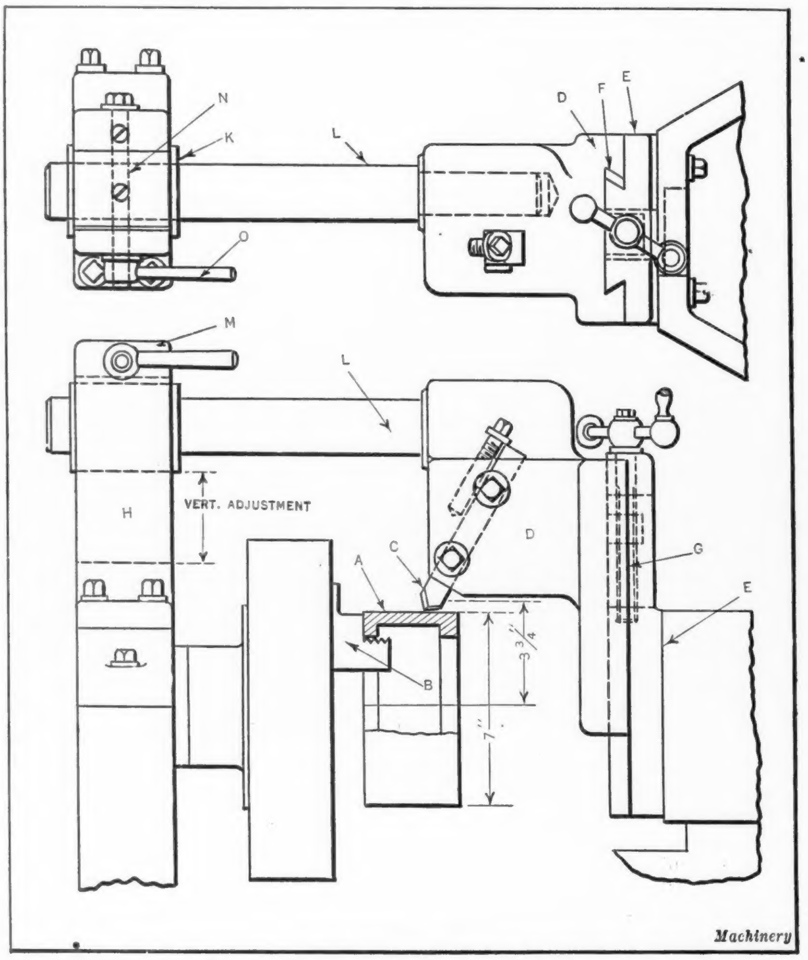
tact is made between it and the inner surface of the sleeve. The trimming tool *L*, held in the cross-slide toolpost, is employed to trim the edge of the cup. As the cup is supported by the ball-bearing race, no burrs are left on the edges, although the shell is very thin. The trimmed shell is removed from the ball bearing by a stripper, which operates on the return movement of the turret.

New York City B. J. STERN

PILOTED ADJUSTABLE TURNING TOOL

When heavy cutting is to be done on a turret lathe and the work is 5 or 6 inches in diameter and several inches long, a number of cuts are often necessary to keep the work within the required limits, and even under these circumstances, there is likely to be considerable chatter, due to the fact that the turning tools are unsupported and spring away from the work. It is sometimes possible to use turning tools in the cross-slide carriage, if this has provision for longitudinal feed. When this is done, however, it slows up production, if there is much facing or forming to be done with the cross-slide.

If there is much work of the kind described, it may be found profitable to make up one or more adjustable piloted turning tools similar to the one shown in the illustration. This particular tool has a range of from 2 up to 7 inches in diameter, and by moving the turning tool in the block, up to a maximum of 7 1/2 inches. The dimensions can, of course, be varied, in designing, to suit the requirements.



Piloted Adjustable Turning Tool for Turret Lathe

In the example shown, the cast-iron cylindrical ring *A* is held by the inside in the chuck jaws *B*. The turning tool *C* is of rectangular section, 5/8 by 1 1/4 inches, loosely fitting a slot in the body of the cast-iron tool-slide *D*. The tool-slide is dovetailed and fitted to the member *E*, which is bolted to the face of the turret. A taper gib at *F* provides a take-up for wear in the slide, and vertical adjustment of the slide is easily made by means of the screw *G*. The headstock of the turret lathe is fitted with a special bracket *H*, which is slotted vertically to receive a steel guide block *K*, through the center of which there is a hole of the same size as the pilot bar *L*. This bar is securely fastened in the body of the tool-holder casting, as indicated. There is a steel filler block *M* bridging the slot in the casting *H*, and through this block passes a bolt *N*, threaded at one end to fit the binder lever *O*.

In making the adjustment for any given diameter, the binder lever is loosened to release the guide block *K*, and the slide is raised or lowered to the desired position. The binder lever is then tightened, which draws the two sides of the slotted guide together and holds the bushing *K* in a fixed position. Any number of pieces may now be turned with very little chance of trouble from chatter and at feeds and speeds not possible with an unsupported tool. It is much better to use a tool of this kind, in which the entire body of the device is shifted to obtain the adjustment, than to design a piloted turning tool in which all adjustments are made by moving the tool itself up or down. When made in the latter way, some of the smaller sizes that need to be turned now and then require an excessive overhang, with resulting chatter of the tool.

Prince Bay, S. I. ALBERT A. DOWD

MACHINE NAMES IN RAISED LETTERS

In the machine tool field, and a number of others in the line of general machinery, manufacturers put their names in cast letters on some part that is always in the line of vision. There are several advantages in using raised pattern letters: They cannot be removed as easily as a name plate; they are more easily read than the latter; and a dealer cannot usurp the most prominent position for his own name.

These letters are usually tipped with gold paint or gilt. White gilt is also in favor. As a rule, this material is bought in small retail packages containing the flake color which is to be mixed with the banana oil. This form answers very well for manufacturers who do not build machinery on a production basis, but there is an objection to it in that the gilt rubs off in shipping or afterward.

To make gilt letters fixed, a small quantity of liquid collodion may be added to the gilt as prepared with banana oil. Only a few drops need be added to such a quantity as can be mixed in the small tin containers that come with these packages. The gilt paint thus prepared dries as hard as shellac and stands an undue amount of abrasion. It may be used satisfactorily for lettering on glass windows on the side exposed to the elements.

Middletown, N. Y. DONALD A. HAMPSON

* * *

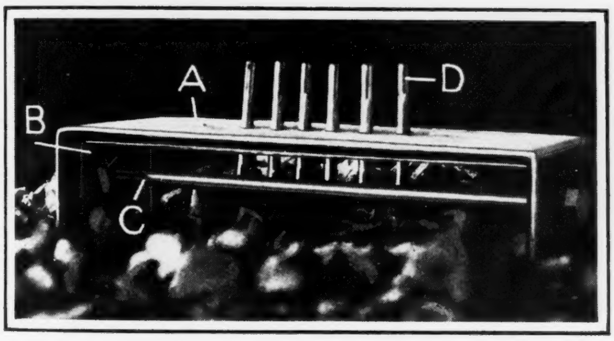
A report presented before the American Railway Society at its convention in Atlantic City last summer, pointed out that the stores and stocks of the railroads of the country are burdened by too great a variety of sizes and kinds of materials. Six railroads, it was mentioned, have eliminated 16,800 items by the use of the American Railway Association's standard material classification. The committee estimated that through elimination of types and sizes, savings amounting to 10 per cent of the annual cost of purchases of the items to which simplification has been applied, can be effected.

Shop and Drafting-room Kinks

PIN TEMPERING FIXTURE

An interesting method of tempering slotted pins in a forge fire recently came to the writer's notice. Both a gas and a coke fire were available, but the latter was employed because it was open and permitted the work to be watched and easily removed when drawn to a deep straw color for approximately the length of the slot. The opposite end was left a deep blue color. The required colors were obtained on a production basis after several trials, by using the fixture shown in the illustration.

The two strips of sheet metal *A* and *B* were bent over at both ends, one piece fitting inside the other, with a space of about 1/4 inch between the two pieces. A hole was drilled through both ends of the metal strips to receive the rod *C*, which was threaded at both ends. Four nuts, two at each end, served to hold the sheet-metal pieces together. Six holes to receive the six pins to be tempered, one of which is shown at *D*, were drilled through both sheet-metal pieces in line with the rod *C*. In use, the fixture is placed over the fire and the six pins slipped into the holes with their ends resting on the tie-rod *C*. The forge blaze is then adjusted to give a slow heat. As soon as a pin shows the correct color, it is



Fixture used in tempering Pins

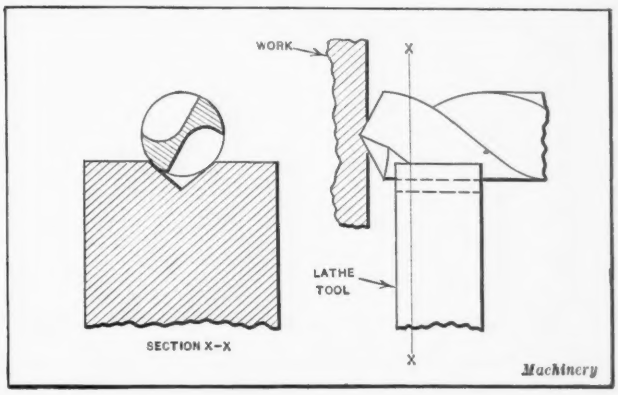
removed and another put in its place. The operation is thus a continuous one. To make sure that the workman will have time to remove each pin at exactly the right time, the pieces are loaded into the fixture one at a time at 1/4-minute intervals.

Montreal, Canada — ARTHUR KENDALL

TRUING UP CENTER MADE WITH DRILL POINT

Before drilling holes in work secured to a faceplate or held in the chuck of a lathe, some method of centering the work is necessary. The usual method is to center the work with a short drill held in the tailstock chuck or with a pointed tool held in the toolpost. However, instead of these methods the following method is sometimes employed. The lathe is set up in the usual manner, except that a drill of the required size and length is placed in the tailstock chuck. The shank end of a lathe tool is then set against the drill near its end, as shown in the accompanying illustration.

It is desirable to have a V-notch in the tool, as shown, but not absolutely necessary. The sectional view also shows the approximate position of the cutting lips of the drill with respect to the lathe tool. With this arrangement, a small spot is drilled in the work, and while it is still rotating, the lathe tool is advanced slightly, causing the drill end to be sprung off center, so that only one lip acts as a cutter, thus truing up the drilled spot.



Method of truing Center made with Drill

After the tool held in the lathe toolpost is withdrawn, the hole is drilled in the usual manner. The truing operation must, of course, be performed before the full depth of the beveled or conical end of the drill has entered the work. With a little practice, the operator can perform the centering and drilling operation quickly, as no time is lost in changing tools in the tailstock spindle.

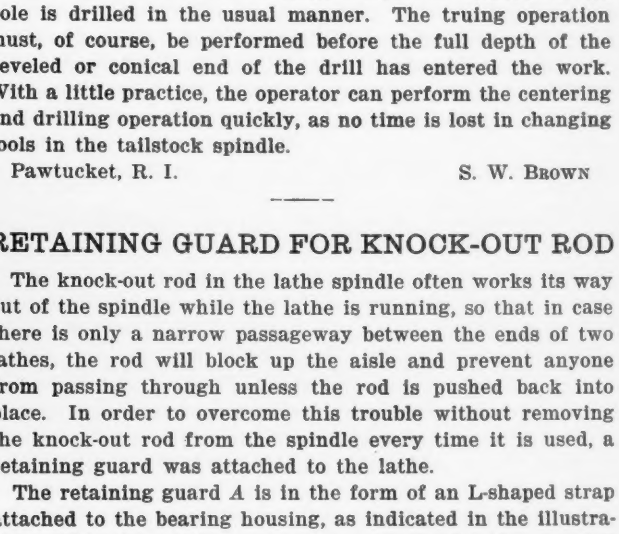
Pawtucket, R. I. — S. W. BROWN

RETAINING GUARD FOR KNOCK-OUT ROD

The knock-out rod in the lathe spindle often works its way out of the spindle while the lathe is running, so that in case there is only a narrow passageway between the ends of two lathes, the rod will block up the aisle and prevent anyone from passing through unless the rod is pushed back into place. In order to overcome this trouble without removing the knock-out rod from the spindle every time it is used, a retaining guard was attached to the lathe.

The retaining guard *A* is in the form of an L-shaped strap attached to the bearing housing, as indicated in the illustration. This strap is long enough to give the knock-out rod *B* sufficient working space to permit driving out the lathe center. The guard is secured to the lathe by two screws. One of the screws *D* passes through a slot, which allows the guard to be raised by simply loosening the screw, so that the knock-out rod can be removed from the lathe spindle when desired.

Waterbury, Conn. — CHARLES DOESCHER

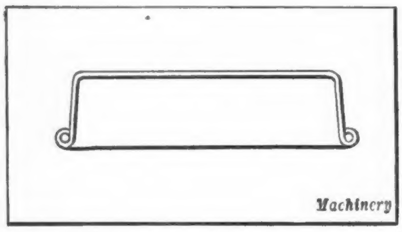


Method of retaining Knock-out Rod

Questions and Answers

DRAWING SMALL CAP WITH ROLLED EDGE

C. N. R.—Will some reader of MACHINERY who has had experience in drawing small shells from tin plate inform the writer if it is possible to draw a cap and finish it with a rolled edge, as shown in the accompanying illustration, in one operation? The cap is to be drawn from 90-pound base tin plate to the size indicated by the cross-section, the depth ranging from 5/16 to 3/8 inch.



Full Size View of Cap to be drawn

STEEL FOR DIE-CASTING DIES

N. M.—What steel is generally used for die-casting dies?

A.—A steel recommended for die-casting dies by one of the makers of die-castings contains 2.25 per cent chromium, from 0.18 to 0.22 per cent vanadium, and from 0.30 to 0.50 per cent carbon. This steel is said to have much greater endurance in die-casting work than steel containing a smaller amount of chromium. It does not "check" or show minute cracks as soon as other steel would. From 80,000 to 100,000 pieces are said to be frequently cast in dies of this kind before any checking appears.

WHAT METALS EXPAND ON COOLING?

N. N.—Can you give me some information about metals that expand on cooling?

A.—Antimony gives to metals the property of expansion on solidification, and hence, is used in type metal to insure completely filling the molds. Type metals are generally made with from 5 to 25 per cent of antimony, and with lead and tin and sometimes a small percentage of copper as the other alloying metals. As specified in MACHINERY'S ENCYCLOPEDIA, Vol. I, page 71, the compositions of a number of type metal alloys are as follows (figures given are percentages):

Lead, 77.5; tin, 6.5; antimony, 16.
Lead, 70; tin, 10; antimony, 18; copper, 2.
Lead, 63.2; tin, 12; antimony, 24; copper, 0.8.
Lead, 60.5; tin, 14.5; antimony, 24.25; copper, 0.75.
Lead, 60; tin, 35; antimony, 5.
Lead, 55.5; tin, 40; antimony, 4.5.

The highest grade of type metal is composed of lead, 50 per cent; tin, 25 per cent; and antimony, 25 per cent.

MEASURING A REAMER HAVING AN ODD NUMBER OF TEETH

J. M. W.—In measuring a reamer having an odd number of teeth, so that opposite pairs of teeth are not on the center line, how is the required measurement determined? Suppose, for example, that the reamer is to have a diameter of 2 inches and there are nine teeth; what is the measurement across an opposite pair of teeth for a reamer diameter of 2 inches?

A.—To determine the measurement when a reamer or tap has an odd number of flutes, first divide 90 degrees by the number of flutes; then multiply the cosine of the angle thus found by the required reamer or tap diameter. Thus, if there are nine flutes, $90 \div 9 = 10$, and the cosine of 10 degrees is 0.98481. This figure would be equal to the chordal measurement if the reamer diameter were 1 inch, but since the required diameter is 2 inches, the measurement over the teeth $= 0.98481 \times 2 = 1.9696$, or 0.0304 inch less than the true diameter.

If the size of a tap with an odd number of flutes is known and the problem is to determine the true size, proceed as follows: First, divide 90 degrees by the number of flutes, and then find the cosine of this angle. Next divide the tap diameter (as measured over the teeth) by the cosine just referred to. The result will be the true tap diameter.

For example, if a tap has five flutes and the measurement over the first and third flutes is 1 3/32 inches, then the true diameter is found as follows: $90 \div 5 = 18$, and the cosine of 18 degrees $= 0.95106$. The dimension obtained by measuring the tap, or 1 3/32 inches, $\div$ 0.95106 = 1.15, which is the true diameter.

MACHINERY'S Data Sheet No. 77, which accompanied the March, 1926, number, gives the chordal dimensions required for measuring reamers or other tools having an odd number of flutes, the distance across jig buttons when there is an odd number located on a circle, or any other class of work requiring a chordal measurement. This table is for a diameter of 1 inch, and to obtain the actual measurement for other diameters, it is simply necessary to multiply the figure given in the table by the diameter required.

WHY DOES HARDENED STEEL SOMETIMES EXPLODE?

H. V.—A drawing punch, 5 inches in diameter and 9 inches long, made from 0.90 to 1.05 per cent carbon steel, burst into about six pieces after heat-treatment, the bursting or explosion being accompanied by a loud report. The punch was subjected to the following heat-treatment: It was first placed in an electric furnace having a temperature of 800 degrees F., and was heated to 1450 degrees F., the time for heating being about five hours. Quenching in a bath of salt brine followed, the temperature of the punch being reduced to about 600 or 700 degrees F.; then the punch was placed in an oil bath until cold. Ten days after the heat-treatment described, the explosion occurred. The steel did not show any defects, but it indicated a great amount of strain, and there was a very coarse structure. What caused this excessive strain?

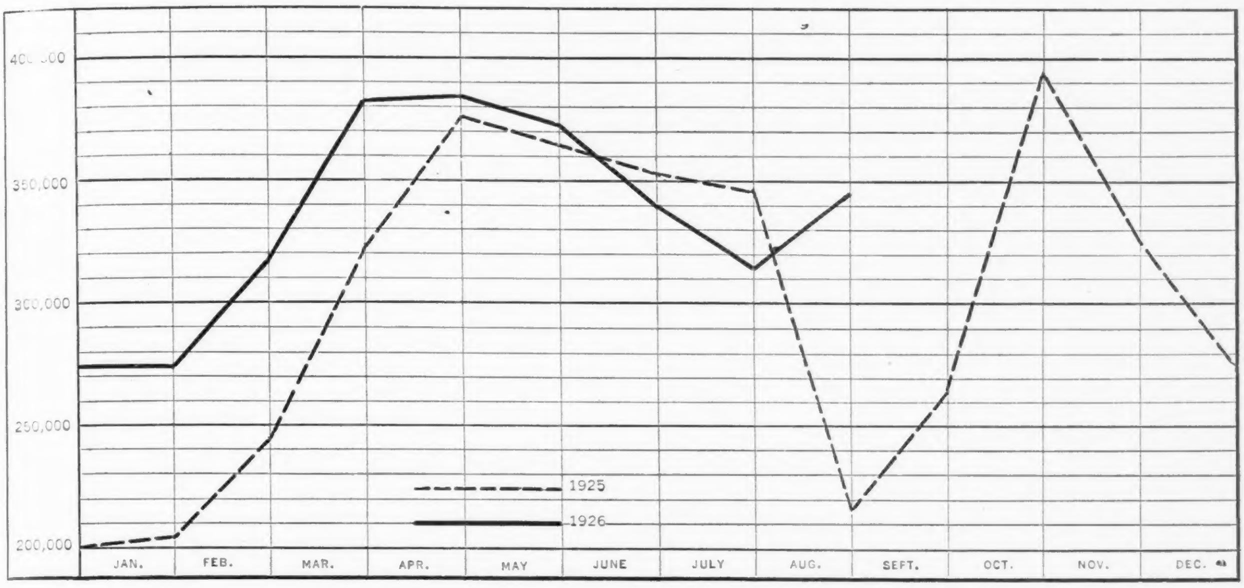
ANSWERED BY CHARLES DOESCHER, FOREMAN, HARDENING ROOM, THE SCOVILL MFG. CO., WATERBURY, CONN.

After quenching the punch in the salt brine bath, it was allowed to cool until it reached a temperature of 600 or 700 degrees F., and was then placed in an oil bath until cold. In view of the fact that the steel showed no defects, I would say that the cause of the explosion was that the internal strains of the punch were not properly relieved.

The mistake made in hardening the punch was that after quenching in a salt brine bath, the work was allowed to cool down in cold oil without any further relieving of the strain after it was removed from the cold oil. After quenching the punch in the brine bath, it should have been put in a warm oil tempering bath at about 300 degrees F. The tempering bath should then have been brought up to a temperature of 350 degrees F., and held there from 1 1/2 to 2 hours. This would have relieved all internal strains caused by hardening and thereby eliminated the cause of the explosion.

A good point to remember is that every time a piece of steel is hardened, internal strains are set up, and these strains must be relieved by drawing. The larger the piece, the greater the internal strains set up, and therefore the longer the time that must be spent in drawing, in order to entirely relieve the strains.

CHART SHOWING MONTHLY PRODUCTION OF PASSENGER AUTOMOBILES IN THE UNITED STATES, 1925 AND 1926



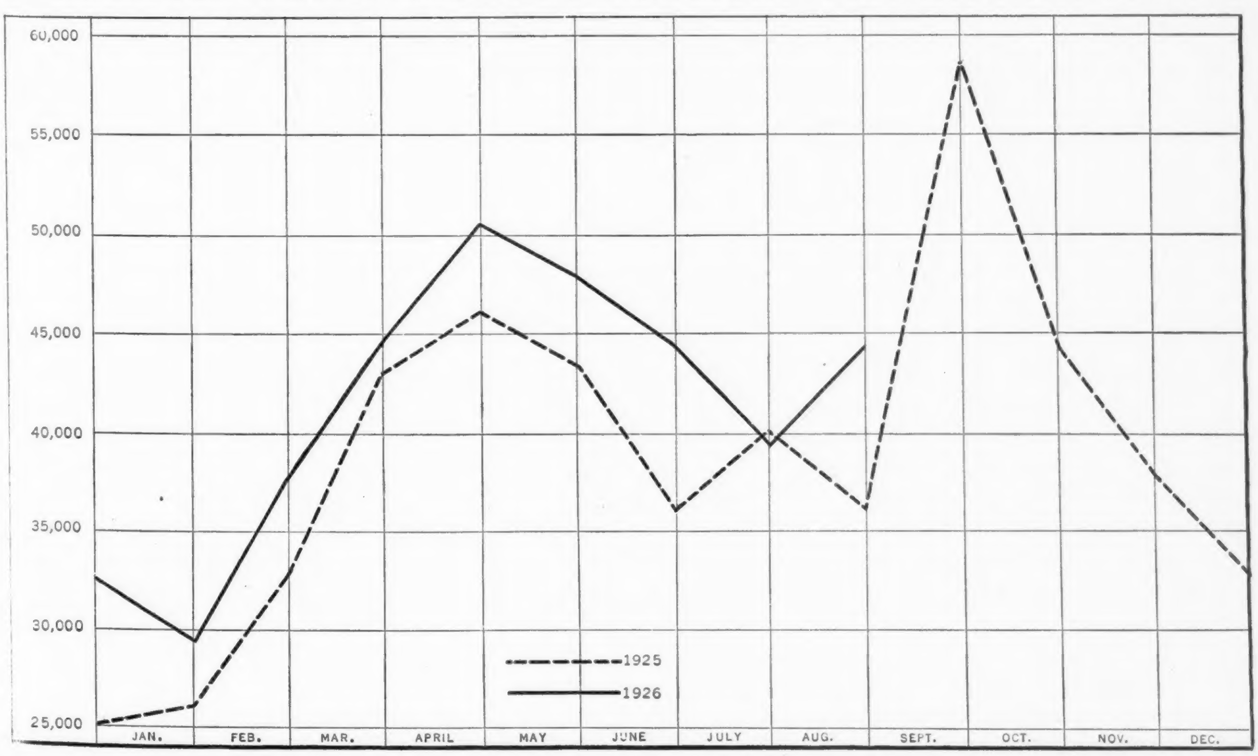
The Automotive Industry

The output of automobiles for the first seven months of 1926 was the highest ever recorded for that period of the year—2,386,000 passenger cars and 294,066 trucks. Both figures are higher than the entire twelve months' production for 1922, which was the greatest output ever achieved up to that time. The output for the first seven months in 1925 was 2,215,115 passenger cars and 269,139 trucks. The accompanying charts make a comparison between the output in the two years, the curve for 1926 being carried up to the end of August. It will be noted that the production in 1926, shown by the heavy line, exceeded that for 1925, shown by the dotted line, in passenger cars for the first five months, and in trucks for the first six months. The charts indicate that there was a decided drop in both passenger car and truck production in June and July, but both curves again rise in August.

In the automobile field, sales are reported good at the present time, and sentiment is everywhere optimistic. Of ten leading automobile companies, all but two report larger sales during this year than last. The drop during the summer was considered normal, and merely of a seasonal character. A lull in production also always attends the introduction of new models. Some of the cars introduced this fall have been accepted very favorably by the buying public.

It is of interest to note that nearly one-half of the passenger car production is now required to replace the number of cars scrapped annually. An estimate of the number of cars that will entirely pass out of the used car market and be scrapped this year places this figure at 1,900,000. Hence, if there were no new buyers at all, 50 per cent of the automobile passenger car production would be required simply for replacements.

CHART SHOWING MONTHLY PRODUCTION OF TRUCKS IN THE UNITED STATES, 1925 AND 1926



The Machine-building Industries

CONTINUED activity in business and manufacturing is reported from almost every industrial field. The Federal Reserve Bank points out that business conditions are generally good, manufacturing at a high level, especially in the iron and steel industry, and that, on the whole, the agricultural situation is satisfactory. Retail trade is ahead of last year, while the building industry, although tapering off, is still enjoying a large volume of business.

The Department of Commerce likewise states that business activity continues to show advances over a year ago. Car loadings have not only exceeded the figures of a year ago, but have reached a record volume excelling all past performance. The curve showing the amount of building contracts awarded has had its ups and downs from week to week, but during the last week of August the awards again increased, exceeding the corresponding week of last year.

July is the last month for which complete manufacturing statistics are available. The Department of Commerce figures show that manufacturing output was 26 per cent in excess of the average for 1919, which is taken as the basis for comparison. The output of iron and steel was 25 per cent, and of all other metals, 73 per cent, in excess of the year mentioned. Contrary to the usual experience in the summer, production increased in July slightly over June, and on the whole, the same rate of activity has continued since that time. The iron and steel industry has had a summer activity never before equalled, and has orders on hand sufficient to carry it for the rest of the year. There is a tendency toward increased prices, as recorded by both Bradstreet's and Dun's indexes. A slight improvement in the textile industry is also an important sign.

August established new records in trade and manufacturing activities, but the improvement was normal and business maintained the healthy tone that has characterized it throughout the year. The industrial activity has developed a shortage of skilled labor in some sections, but so far, there has been no indication of undue bidding for labor. Instead, manufacturers are pursuing the conservative course of quoting deferred deliveries to spread the work over a longer period of time. All this tends to prevent an excessive upward turn of the business curve, and will, in turn, prevent excessive depression later on.

Buying is Still Largely from Hand to Mouth

Fifty large manufacturing concerns were recently requested by the Federal Reserve Bank of Cleveland to state whether there was any tendency on the part of customers to purchase more liberally for future needs, or whether buying was still for immediate needs only. The replies show emphatically that the hand-to-mouth buying policy is still being almost universally pursued. Less than 25 per cent of the replies reported an increase in buying for the future, and in several of these cases, the increase was only slight. Nearly 80 per cent of the replies stated that consumers are still covering their future needs in the most conservative manner, and that this tendency appears to be increasing.

A number of replies commented upon the fact that nearly all orders request "rush delivery." In many instances, customers expect manufacturers to carry the required stock on hand ready for immediate shipment, and such demands are even made in cases of concerns whose goods are largely made to order. Practically all manufacturers have adjusted themselves to this new buying policy, although there is considerable dissatisfaction with the results. One reply points out that there is an advantage in the buyers not over-stocking, as they are better able to pay immediately for what they buy than they are when they buy for needs far in the future —a type of buying that partakes of speculation.

The Machine Tool Industry Continues to be Fairly Active

Machine tool builders have passed through a fairly active summer, the usual seasonal decline not having been experienced. The net orders in August fell but little below the orders placed during the preceding month—probably not more than 5 per cent. The unfilled orders at the end of the month were larger than at the end of the preceding month, because shipments in August were less than in July. The average trend of business in the machine tool industry is upward rather than downward, the business volume during the three summer months being larger than in the late spring.

Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, states: "Conditions have shown little relative change from the level of prosperity of many months past, and we may fairly continue to expect as good a demand for machine tools as we have been having, until there are more definite signs of a change either way. Altogether, the country has been operating this summer on a level of general business activity that has been higher than at any time since the war. To continue this level of prosperity will require persistent caution on the part of business men. It is just at a time when everything is most favorable to business that caution disappears. It would be wise, therefore, for the machine tool industry not to accumulate inventories that might become excessive should the present rate of demand recede. Judging from the past, it would be well not to count on the present high level of the business tide continuing indefinitely. More losses have been caused by over-optimism than by conservatism."

In the small tool industry, there has been a decline in sales from the unusually high level reached earlier in the year. This is doubtless accounted for by the gradual slowing up of automobile production during the summer months, and an increase in this business may reasonably be expected as automobile production begins to increase again after the seasonal lull of the summer.

Exports of Industrial Machinery from the United States Show Gain

The exports of industrial machinery from the United States during July totaled $14,173,000, as compared with $13,401,000 for the corresponding month of 1925, and $11,-115,000 for June this year. The July exports were the largest reported for any month this year, with the exception of April, and during the last two years have been exceeded only by that month and by August, 1925. The exports of metal-working machinery amounted to $1,690,000, as compared with $1,382,000 for June. At the rate now being maintained they will amount to about $20,000,000 for the year.

The Iron and Steel Industry has had a Banner Year

The output of the iron and steel industry for the last four months has exceeded all expectations. The summer demand for steel maintained the highest level in history, for that season; July and August booking were larger than ever experienced before for those months. Consumption is in widely diversified channels, and does not depend upon one industry or line of industries alone; in spite of the high rate of production and shipments, unfilled orders have increased. During the last week of August, the United States Steel Corporation's ingot output was nearly 85 per cent of capacity, while for the entire industry it was somewhat less than 80 per cent. Except during four months, the rate of production in this industry has stood at about 80 per cent, or over, of the theoretical capacity, for two years. This is by far the longest sustained period of peace-time activity in the history of the industry.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

WICKES SEMI-AUTOMATIC CRANKSHAFT LATHE

A semi-automatic lathe designed for machining the center bearing, flange end, and front end of automobile crankshafts has recently been developed by Wickes Bros., Saginaw, Mich. In the general view presented in Fig. 1, this machine is shown tooled for straddle-facing the flange, turning the flange periphery, and forming the oil-groove and oil-throw ring. Fig. 2 shows the machine equipped with tools for machining the rear bearing, flange, oil-groove, and oil-throw ring, while Fig. 3 shows the machine arranged for taking various cuts on the front end of the crankshaft.

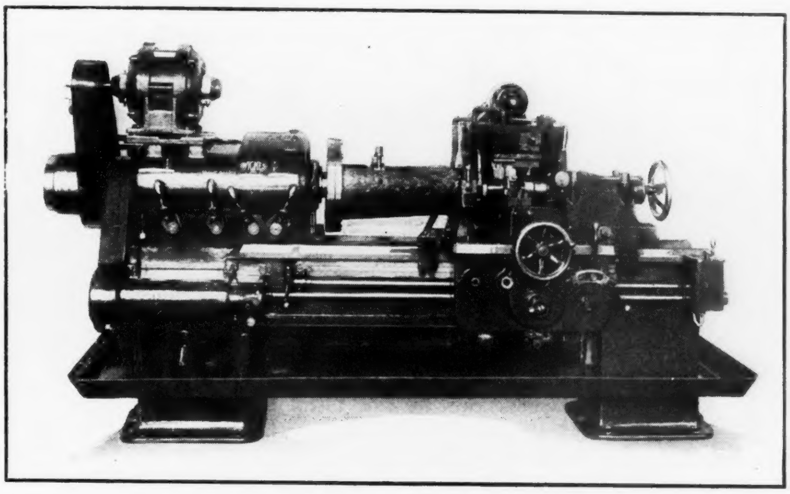


Fig 1. Wickes Semi-automatic Crankshaft Lathe of Special Design

The machine is driven by a silent chain from a 7 1/2-horsepower constant-speed motor running at 1200 revolutions per minute. The headstock is equipped throughout with heat-treated chrome-nickel steel gears, and provides twelve spindle speeds. Eight feeds are obtainable through the feed-box. Both power cross-feeds and power longitudinal feeds are provided, and there are automatic cross-feed and longitudinal-feed stops. Changes of the cross-feed are obtainable automatically to suit the cuts. In starting the cross-feed of the tools, only a small amount of metal usually has to be removed, and so the feed is rather coarse; however, as the tool bits move toward the finished diameter of the work, the cuts become much heavier, and the feed is automatically reduced, so as not to overload the tool bits or the machine.

From the illustrations, it will be seen that the rear tools are carried on an inverted slide, which allows the chips to be easily carried away without interfering with the cutting tools or the cross-slides. With the tooling set-ups shown in Figs. 1 and 3, both the front and rear tool bits are fed straight toward the center of the machine without any longitudinal movement. In the case of the tooling shown in Fig. 2, the front tools are fed longitudinally at the same time that the rear tools are fed toward the center of the machine. In each operation, the crankshaft is supported on a center bearing by means of a roller-type steadyrest, and it is driven through a suitable head. The steadyrest and drive-head prevent deflection of the cranks under heavy loads. The tailstock is generously proportioned and provided with an anti-friction live center. The construction of the entire machine, as well as of the back tool housing, which carries the rear tool bits, is very rigid, permitting extremely heavy cuts to be taken.

In addition to the features mentioned, the machine is provided with the Wickes patented electric rapid cross-traverse to the tool bits. The controller for the rapid cross-traverse motor is mounted near the apron in a convenient position for the operator. By means of the traverse, the tools are brought quickly into the cutting position, and after the completion of the cuts, are again rapidly placed in the unloading position. The machine is provided with a coolant pump and tubing and with a chip pan.

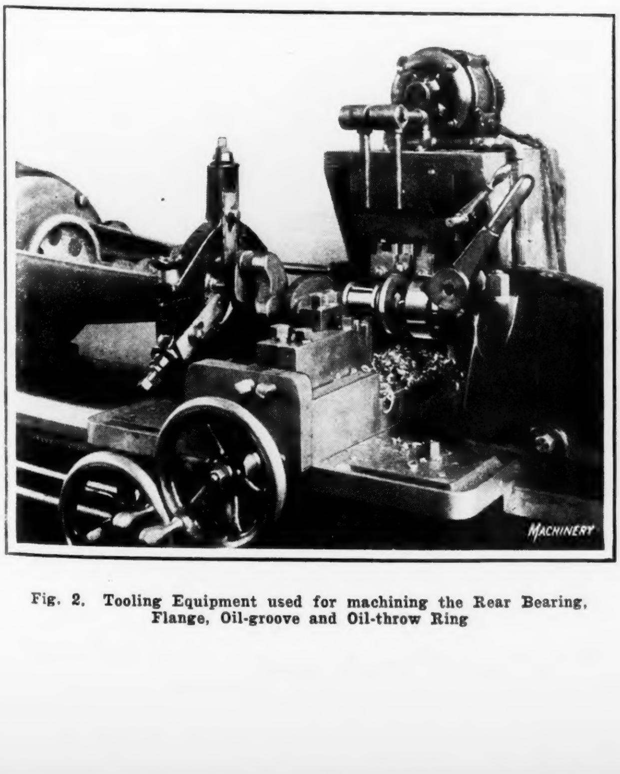
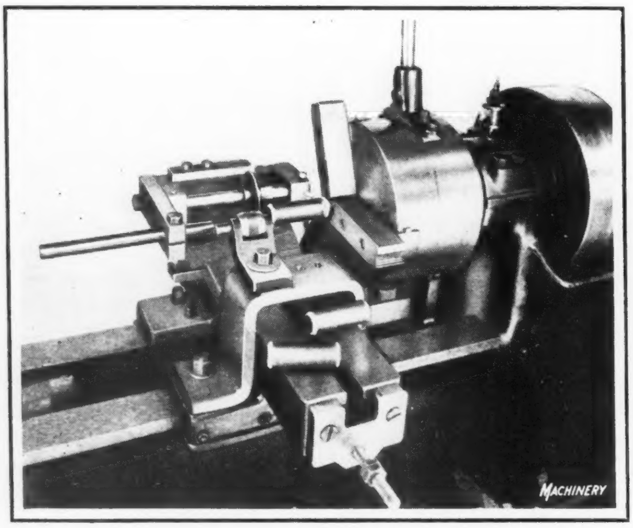


Fig. 2. Tooling Equipment used for machining the Rear Bearing, Flange, Oil-groove and Oil-throw Ring

Fig. 3. Machine tooled for taking Various Cuts on the Front End of Automobile Crankshafts



Penn "Chamfer-cutter" for producing Pipe Nipples

PENN NIPPLE "CHAMFER-CUTTER"

Nipple blanks may be chamfered and cut off from lengths of pipe in one operation in a "chamfer-cutter" recently placed on the market by the Penn Engineering Co., 3rd St. and L. V. R. R., Reading, Pa. The advantages claimed for this method are that nipples are produced without a ridge of hard crystallized metal on the outer edges and without a burr on the inside edges of the hole; there is also no danger of opening the seams of pipe. On account of this, it is not necessary to chamfer or ream the nipple blanks prior to threading, and hence increased production rates can be maintained.

The pipe is gripped in a three-jaw chuck that is operated by means of a hand-lever. When the chuck is released at the beginning of an operation, the pipe moves forward to a stop through a distance equal to the desired length of the nipple. From the illustration, it will be seen that two tools are used in the operation—a tool bit which is set at an angle for chamfering the pipe close to the chuck jaws, and a rotary-disk parting tool positioned sidewise from the tool bit a distance equal to the length of the nipple being produced. After the pipe has moved against the stop, it is regripped in the chuck, and then the tool carriage is advanced toward the center of the machine, causing the tool bit to cut a deep groove in the pipe, and the rotary disk to cut off the nipple at the point where the pipe was grooved by the tool bit in the preceding operation.

PRATT & WHITNEY AUTOMATIC WORM-GRINDING MACHINE

An automatic machine developed for grinding threads on a production basis is being placed on the market by the Pratt & Whitney Co., Hartford, Conn. One of the fields of application for this machine is the grinding of automobile steering worms and driving worms. This machine will finish either single or multiple threads on one or both sides, as desired. The only attention necessary on the part of the operator consists of loading and unloading the work and dressing the grinding wheel. The grinder is a precision machine as well as a production machine and can grind to close limits while under operation at high speed.

The machine consists of a large bed which supports a sliding table and a wheel-slide, these two units being located at right angles to each other. The table carries a work-driving head and a tailstock. All controls are located on the front of the bed, and change-gears provide the necessary work speeds. A motor drive only is provided for the machine. For all thread depths up to 0.400 inch, the motor is of five-horsepower capacity, of the constant-speed type, and runs at 1150 revolutions per minute. It is furnished for either alternating or direct current, with suitable starting and controlling equipment. For thread depths from 0.400 to 9/16 inch, a 7 1/2-horsepower motor is required. The motor is mounted on a pad on the bed, and is belt-connected to the various mechanisms. A friction clutch is provided for starting and stopping the work and the table.

The wheel-head is so arranged that the grinding wheel may be swiveled 30 degrees to the right and 45 degrees to the left to suit any thread angle. Graduations facilitate accurate settings. The drive to the wheel is through a pair of spiral bevel gears running in oil. A belt drive is used between the bevel gears and the grinding wheel to insure smooth operation of the wheel. A left-hand screw, to which the handwheel on the front of the bed is attached, is employed to feed the wheel to the desired depth. This screw is equipped with a power feed ratchet having 200 teeth, which is operated by dogs on the table. One tooth of this ratchet wheel is equal to a feed of 0.00025 inch.

The machine is arranged to grind in one direction only. At the end of each stroke, after the grinding wheel has passed through the thread, the wheel-slide is automatically withdrawn and the table returned to the starting point. Then the wheel again moves in to the proper grinding depth, this cycle being continuous as long as the machine is in operation. The grinding is performed on dead centers. The movement of the table is controlled entirely by a cam, and the maximum travel is 7 inches. The cam is specially cut

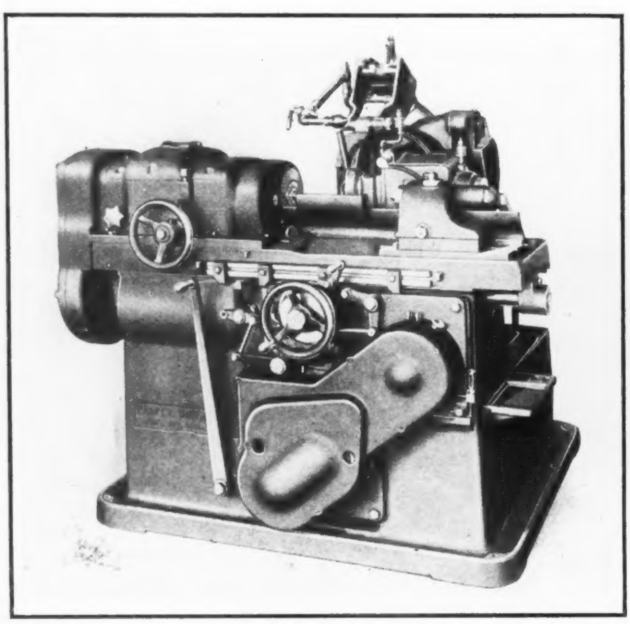


Fig. 1. Pratt & Whitney Automatic Machine for grinding Automotive Steering and Driving Worms, etc.

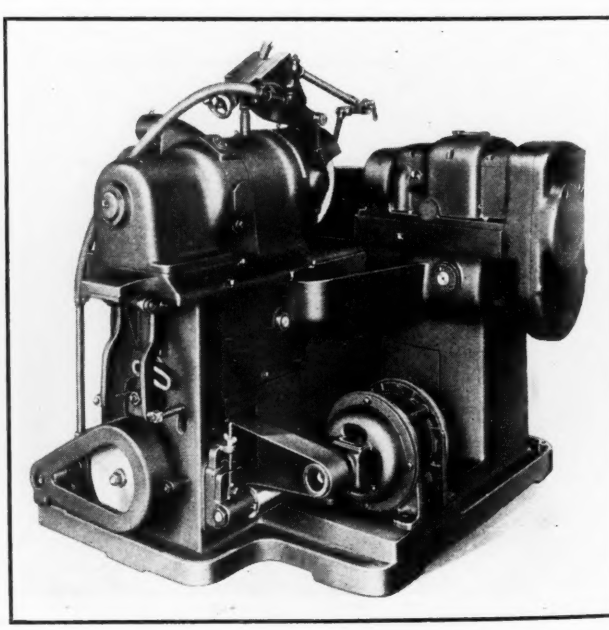


Fig. 2. View showing Arrangement of the Grinding Wheel Slide, which is located at Right Angles to the Work-table

to suit the lead of the work, and controls both the lead and the quick return of the table. The cam is hardened and ground, and rotates at a constant speed in one direction.

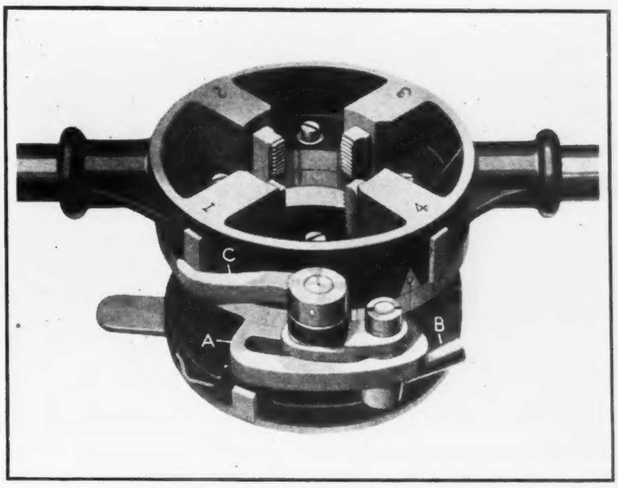
The work-head is connected to the lead cam through suitable gearing, and is also tied to the other mechanisms of the machine so as to synchronize all the movements. A simple device takes care of the indexing of the work-head for worms of multiple threads. While the wheel is out of engagement with the work during the return stroke of the table, the work is automatically advanced through the fraction of a turn necessary to bring a new thread in line with the wheel. Multiple threads of any number may be ground as long as the lead angle range of the machine is not exceeded. A handwheel on the work-head that operates a differential gear may be used to change the relation between the work and the grinding wheel. This handwheel provides an easy means of "picking up" a thread when setting up a piece of work. It may also be used for feeding the work longitudinally when only one side of a thread is being ground.

A truing device is mounted above the wheel in such a manner that it may be swung down when needed, but it is entirely out of the way during grinding operations. This truing device moves a diamond across the wheel face against two steel guiding pins. The machine is equipped with a water pump, tank, and suitable piping, so that a continuous stream of coolant may be delivered to the grinding wheel and then returned to the tank.

BEAVER ADJUSTABLE DIE-STOCK

In a new Beaver adjustable die-stock now being introduced to the trade by the Borden Co., Warren, Ohio, the die adjusting cam is underneath the dies. With this arrangement, all obstruction above and around the dies is eliminated, and the full width of the dies is exposed above the body of the tool so that oil may be freely applied directly on the dies. The improved construction of this No. 70 series die-stock also gives a solid wall opposite or in back of the die throats, which reduces the tendency of the dies to tip when brought against the pipe and causes them to take hold easily and start threading. The open construction permits chips to fall away from the dies readily.

The cam lies between the die-head and the body casting, where it is protected from injury. Extension *A* is an integral

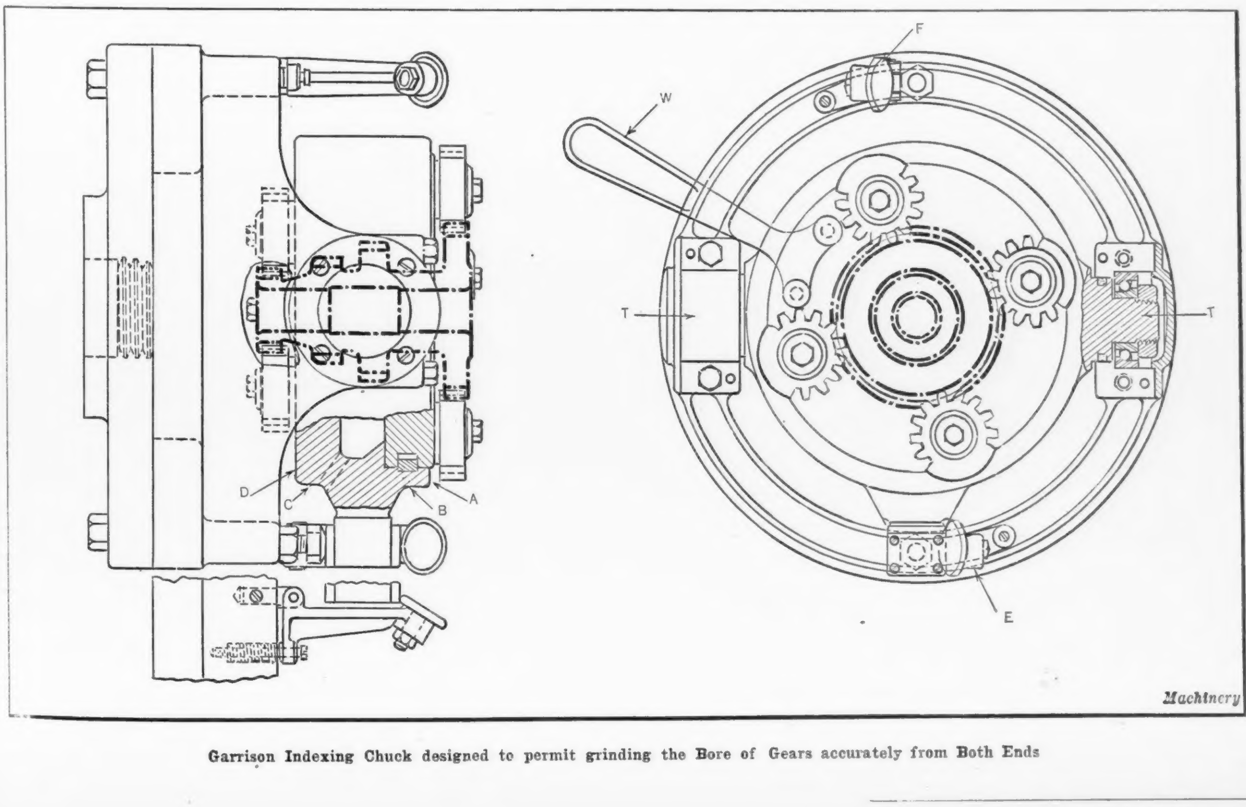


Beaver Die-stock with Adjusting Cam underneath the Dies

section of the die cam which serves as part of a locking device and has an adjusting handle. Lever *B* is used to clamp the cam firmly, but as an added means of insuring against slipping, section *A* of the cam is made wedge shaped. When lever *C* is pulled toward the left, the dies are opened sufficiently to clear the pipe. This feature saves time and prevents damage to the dies when backing the die-stock off the finished thread. When the lever is turned back into the position illustrated, the dies are set to duplicate the previously cut thread. The dies can be quickly changed without removing other parts and without the aid of tools.

GARRISON INDEXING GEAR CHUCK

An indexing fixture that facilitates the accurate grinding of deep holes, relatively small in diameter, from each end of gears, has recently been developed and patented by the Garrison Machine Works, Dayton, Ohio. After the bore of a gear held in this chuck has been ground to the desired depth from one end, the chuck is indexed through 180 degrees to present the opposite end of the hole to the grinding wheel. The remainder of the hole can then be conveniently finished. This method enables a larger and stiffer grinding wheel spindle to be used than would otherwise be possible,



Garrison Indexing Chuck designed to permit grinding the Bore of Gears accurately from Both Ends

and thus permits the work to be ground with greater accuracy and speed.

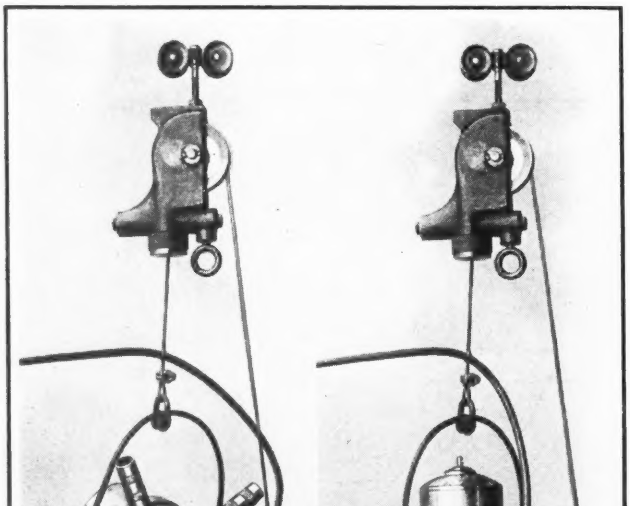
The fixture comprises a standard Garrison duplex chuck containing an indexing lug and trunnions *T*, which permit rotation of the chuck for indexing purposes. The trunnions run in ball bearings that are rigidly supported. The fixture is designed to be mounted on the faceplate of a grinding machine work-spindle. When thus mounted, it should be trued up from the surfaces *A*, *B*, *C*, and *D*, after which it requires no adjustment. Latches *E* and *F* are so constructed as to automatically lock and hold the chuck in either of the two indexed positions without exerting undue pressure or strain on any part of the chuck or fixture. Both latches are released by a mere touch of the operator's finger, to permit indexing the chuck.

In operation, the gear to be ground is inserted in the chuck as shown by the heavy dot-and-dash lines, being locked in position on the pitch line of the teeth simply by operating the movable wrench *W*. Both ends of the gear are locked or unlocked simultaneously by one movement of the operating wrench, for grinding or reloading the chuck, respectively. In the illustration, a cluster gear is shown being held by means of the two outer gears, four chucking members engaging with each of these machines.

MALL HIGH-FREQUENCY PORTABLE TOOLS

A line of high-frequency portable tools is being introduced on the market by the Mall Tool Co., 8389 S. Chicago Ave., Chicago, Ill., for grinding, automobile-body surfacing, sanding, and similar operations. One tool consists of an abrasive-covered wheel equipped with a pneumatic cushion that furnishes a certain flexibility and is still firm enough to grind metal. This tool can be applied to irregular and curved surfaces. Another tool comprises a belt sander designed for imparting a finish to wood without leaving circular marks.

The tools here illustrated are made in two different styles —the No. 1220, which is equipped with a horizontal motor of 3/4- or 1-horsepower capacity; and the No. 1180, which is provided with a vertical motor of 1- or 1 1/2-horsepower capacity. These machines were primarily developed for smoothing metal surfaces prior to the application of lacquer finishes, but they can, of course, be used for many other purposes as well.



Mall Portable Tools for Grinding, Sanding, and Similar Operations

Universal Electric Hoist placed on Market by Louis E. Emerman & Co.

UNIVERSAL ELECTRIC HOIST

An electric hoist equipped with a universal motor for operating interchangeably on direct- or single-phase alternating current of 110 or 220 volts has been placed on the market by Louis E. Emerman & Co., 1761 Elston Ave., Chicago, Ill. This hoist is built in 500-, 1000- and 2000-pound capacities, and weighs 95 pounds complete with 12 feet of load chain and a hook. The minimum head room from hook to hook is 11 inches.

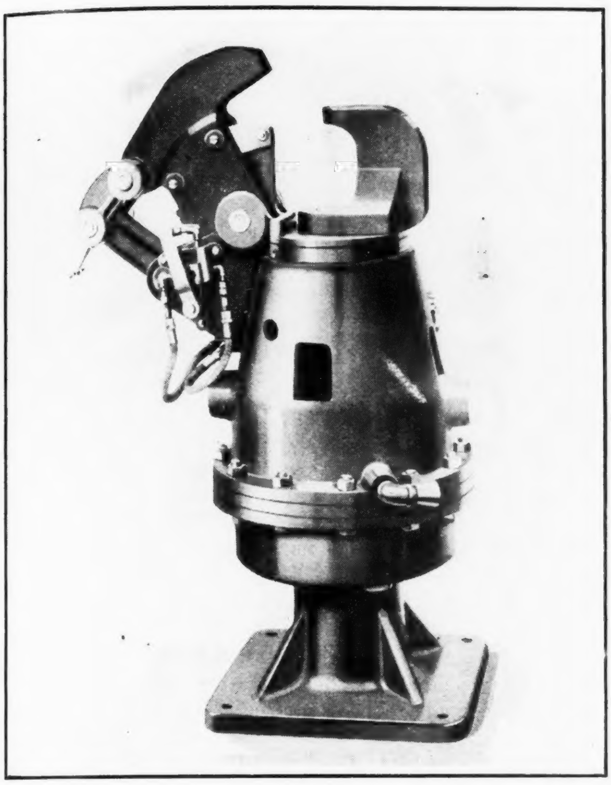
Current for operating the hoist may be taken from an ordinary lighting socket. A limit stop shuts off the current when the hook reaches the upper limit of its travel. Holding or lowering brakes are not required; consequently, a hook may be placed on either or both ends of the load chain. The 1000-pound hoist has a no-load hook speed of 22 feet per minute. With a load of 1000 pounds, the hook rises at the rate of 12 feet per minute. With no load, the hook speed of the 2000-pound hoist is 11 feet per minute, and with a 2000-pound load, 6 feet per minute.

HANNA CLOSED-YOKE RIVETER

One of the automotive riveting operations for which the Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill., have designed a special line of machines is the riveting of the chassis frame. In this line, each machine is particularly adapted to certain class of rivets in almost all chassis frames. One of these, the Hanna turret riveter, was described in June MACHINERY, page 830. Another is the Hanna closed-yoke riveter shown in the accompanying illustration. This recent development is used in driving the vertical rivets in the upper flange of a chassis frame side bar, rail, or channel, which hold the cross-members, etc., in the final assembly riveting.

The chassis frames are conveyed on a monorail suspension rigging through the line of stationary riveters. The frame is suspended in the position it assumes in the automobile. Its side-bar channels are, therefore, always on edge, with webs vertical and flanges horizontal, the webs facing out and the flanges pointing toward the center of the frame.

The inner lower swiveling die or nose is horn-shaped to hook around the lower flange of the side-bar channel. It swivels upon a vertical axis, and therefore can be placed in



Hanna Closed-yoke Riveter for Chassis Frames

various positions to avoid interference with the sides of cross-members, brackets, etc., on the inside of the frame. The die alignment is not affected by this swiveling, as the vertical axis of rotation passes through the center of the die. The outer upper jaw or nose rarely meets any interference as it hooks over and outside the side-bar channel. Its throat stands away from the outside face of the side-bar channel web to avoid brackets, etc.

During the riveting power stroke, which is vertical, the lower nose is stationary and the upper jaw moves. The length of stroke is 1 1/2 inches, and it is a straight-line movement. The inner and outer noses completely enclose the side-bar channel, as the name "closed-yoke riveter" implies. The depth or width of web of the channel is frequently as great as 7 inches.

In order to insert and remove the work, a die stroke of 8 inches, which is impractical, would be necessary unless the outer jaw swung outward, as the illustration shows. This swinging movement is accomplished with toggles which are air-actuated. They are self-locking against the riveting tonnage due to swinging beyond the straight line against a solid stop. The air valve and handle controlling the toggles are shown mounted on the side of the outer jaw head. This opening and closing action is very rapid, requiring less than a second in actual riveting procedure. Furthermore, the opening and closing of the jaw takes place, on an average, only three times for all the top flange rivets on one side of a chassis frame, of which there are usually about fifteen.

This riveter is mounted upon a swivel base, which allows the entire machine to rotate upon a vertical axis. It may also be equipped with a trunnion stand base, which supports the riveter by the two bosses shown on the side of the cylinder. This mounting allows the riveter to tilt so that the die axis conforms to rivets that are at an angle in a chassis. A mounting which combines swivel and tilting is also available.

The closed-yoke riveter is made in 10-ton, 15-ton, and 20-ton capacities for cold-riveting 1/4-inch, 5/16-inch, and 3/8-inch rivets, respectively. Movement of the riveting mechanism is controlled by a foot-operated valve. The operator steps on a heel pedal, and the rivet die advances; lifting the heel reverses the valve, and the die returns. The ease with which the valve is actuated (merely rocking the foot from toe to heel), combined with the "rapid" riveting mechanism and quick indexing, make for high riveting production. The riveter may be operated as fast as fifty cycles per minute.

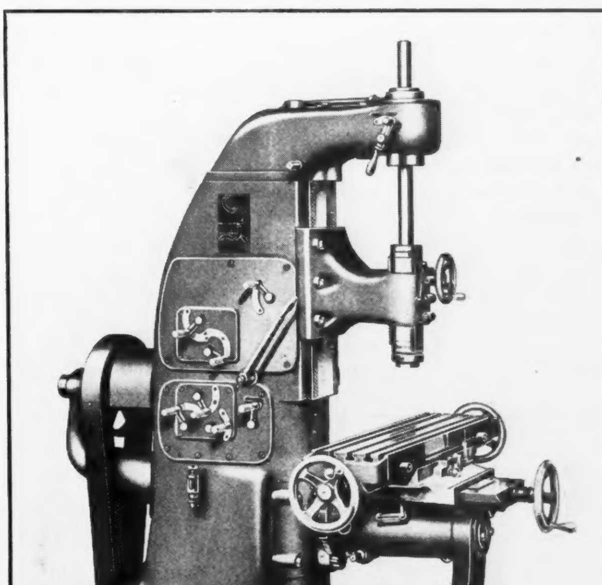
The machine occupies a floor space of 22 by 22 inches, and is 45 inches high. Work may readily be passed over the riveter in its progress through the line. Little, if any, foundation or anchorage is required. An idea of the capacity of the closed-yoke riveter may be gained from the fact that the time required to pass a frame through it, while fifteen rivets are driven, is two minutes.

KNIGHT MILLING AND DRILLING MACHINE

Milling, drilling, boring, shaping, and similar operations may be performed with the No. 4 miller now being introduced to the trade by the W. B. Knight Machinery Co., 3920 Pine St., St. Louis, Mo. Because of its versatility, several operations can often be carried out with one chucking of the work that would ordinarily require a number of machines and set-ups. This machine differs in quite a few respects from former models built by this company. For instance, the machine is of unit construction, with a closed column and with one casting replacing several castings used in previous models. Instead of a countershaft drive, the machine is driven through a Johnson friction clutch.

Another improvement is that the knee has a direct bearing on the base of the machine, instead of on the lower end of the column. Also, the table is tilted by means of a worm mechanism instead of by hand. All gears and clutches are made of heat-treated alloy steel, and force-feed lubrication is provided to all gears and bearings within the column. The drive is through a silent chain from a built-in motor in the base. Cutters are held by means of a special adapter collet instead of by a draw-bar. The spindle nose is arranged for imparting a positive drive to the cutters.

The combined column and base casting is heavily ribbed and has large bearing surfaces for other parts. The entire table unit is arranged to swivel around the column, which considerably increases the range of the machine. The projecting arm on which the knee, saddle, and table are mounted, not only has a large bearing on the column, but is also rigidly supported at the outer end. The knee, saddle,



Knight Miller designed for performing a Large Variety of Operations

and table unit may be tilted around the projecting arm 45 degrees from the horizontal on either side. The degree to which it is tilted is indicated by a graduated segment. When the table is in the horizontal position, a taper pin is placed through the knee and the projecting arm to insure rigidity and alignment. The tilting feature of the table is of particular value in machining several surfaces at different angles on one piece of work, as it makes such operations possible without special angle cutters. It also eliminates the need of many jigs and fixtures.

The spindle head may be raised and lowered by means of a screw, and locked solidly in the desired position. This gives the advantage of a fixed-head construction, and also increases the capacity of the machine. The spindle runs in solid bronze bearings, the lower one being 12 inches long and tapered to provide means of compensating for wear. The compensating is done by simply loosening the top adjustment nut, drawing the bearing down on the spindle, and then tightening the lower nut. The nose of the spindle is threaded and recessed to provide a positive drive for cutters and for the adapter sleeve used in holding small tools.

Both feed and speed changes are accomplished through a sliding gear transmission, which is so designed that all gears not in use are locked in neutral. The spindle speed gears are assembled in one unit, which is mounted on the left-hand side of the machine, while the feed gears are located in another unit placed directly beneath. The speed- and feed-change, starting, brake, and reversing levers, as well as the table and spindle feed controls, are all within convenient reach of the operator. A large range of feeds and speeds is provided to permit the use of the proper speeds and feeds in any of the many operations for which the machine may be used. The power feed to the spindle is reversible, and stops are provided to prevent over-travel of the spindle. The table may be locked for boring operations.

Three hardened and ground steel posts known as "precision locators" may be specially fitted to the machine. These posts adapt the machine for jig boring and similar work requiring accurate spacing and machining of holes. With these posts and the use of a micrometer, vernier, or gage-blocks, the operator can quickly and accurately lay out one hole from another.

RIVETT BENCH LATHE

A "Junior" bench lathe No. 507 comprises the latest addition to the line manufactured by the Rivett Lathe & Grinder Corporation, Brighton, Boston, Mass. Equipped with various attachments that may be provided, this lathe can be readily set up for turning, drilling, boring, milling, grinding, and other operations. It is intended for use in the tool-room and in manufacturing and repair departments, automobile service stations, etc. The regular machine is illustrated in Fig. 1 equipped with headstock and tailstock centers, while Fig. 2 shows the milling attachment being used for producing teeth in a milling cutter. Fig. 3 shows a lever attachment for the tailstock.

The headstock is furnished with means of adjusting to maintain a true-running spindle. One of the features of the spindle is that the nose has an external taper instead of the conventional threads. It is claimed that this construction insures that faceplates, chuck plates, jaw chucks, and other attachments mounted on the spindle will run true. The friction between the tapered surface of the spindle and the tapered hole in the plate, is supplemented by two cone-point screws to hold the plate in place. It is impossible for the plate to slip off, even when turning a piece of stock that extends a considerable distance from the plate. The maximum size of stock that can be passed through the headstock spindle, when held centrally in a jaw chuck, is 7/8 inch. The spindle bearing boxes are made of cast iron, with straight holes, but they are tapered on the outside and split so that when they are drawn into the headstock casting by means of screws, they are compressed and thus take up side shake. Adjustments also provide for taking up end thrust in both directions.

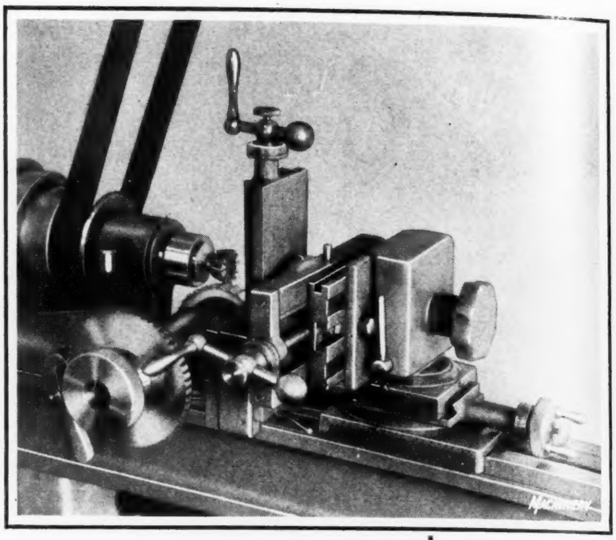


Fig. 2. Machining Teeth on a Milling Cutter by the Use of the Milling Attachment

The tailstock is of the offset type to give ample clearance for the compound slide-rest feed-screw handle when machining short work of small diameter. The tailstock spindle may be locked by means of a small lever on top, which operates a friction bushing. A single measuring line is etched on the spindle to provide for drilling and counterboring holes to the desired depth by measuring with a steel rule. The top of the bed is finish-machined and hand-scraped to gages so that all the attachments that fit on the bed are interchangeable.

The compound slide-rest consists essentially of two slides having a graduated swivel between them and feed-screws for actuating the slides. A guide plate permits the slide-rest to be quickly set in proper alignment with the remainder of the machine, no matter how often the rest is removed from the lathe. The swivel is locked in position on the cross-slide by means of an eccentric binder. Graduations are cut on the dial in degrees to facilitate settings. Two T-slots are machined on the top slide, so that the tool-holder may be mounted to give the least possible tool overhang. These T-slots can also be used in strapping work to be milled or drilled, and in mounting the index-head, a vise, an angle-iron, and grinding attachments.

The countershaft is a single unit which may be mounted in any one of several positions. Belt-shifters for the countershaft are operated either by foot-treadles bolted to the floor or by hand-controlled shifters. Some of the important specifications of the machine are as follows: Length of bed, 38 inches; maximum distance between centers, with the tailstock flush, 17 inches; maximum swing over bed, 8 inches; maximum swing over top slide of compound rest, 1 7/8 inches; maximum swing over bottom slide

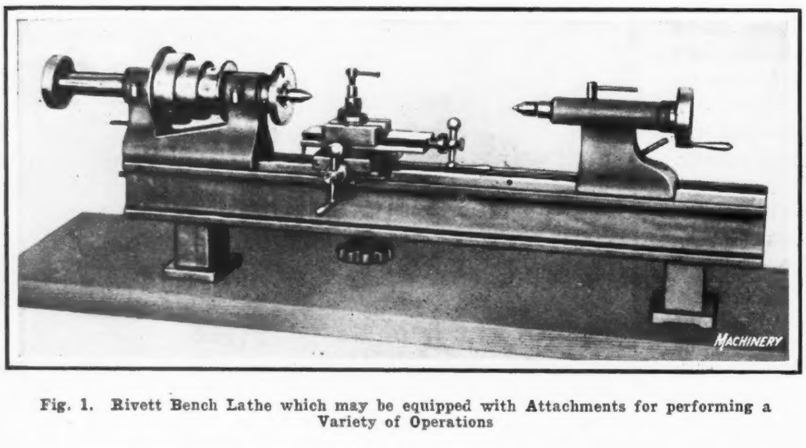


Fig. 1. Rivett Bench Lathe which may be equipped with Attachments for performing a Variety of Operations

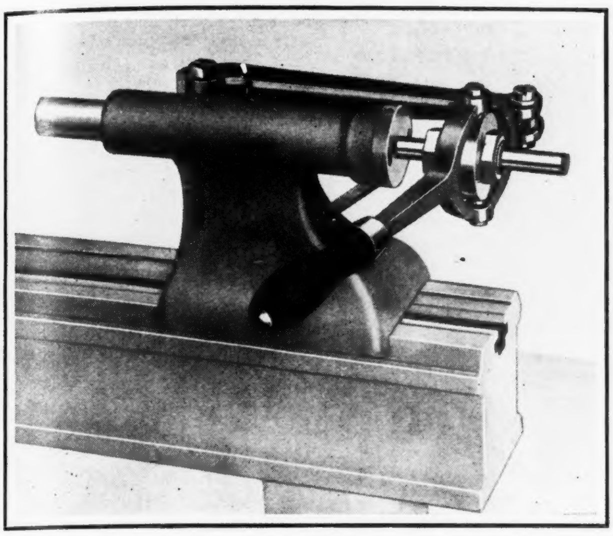


Fig. 3. Tailstock equipped with a Lever Attachment for the Spindle

of compound rest, 5 inches; and net weight of machine, 200 pounds. Numerous other attachments, in addition to those illustrated, are manufactured for use on this lathe, among which are grinding countershafts, lever chuck-closer, thread-cutting attachment, internal grinding attachment, external grinding attachment, angle-iron, vise, turret attachments, cutting-off and forming slide, and steadyrest.

PRATT & WHITNEY D. L. GAGES

About a year ago, the **Pratt & Whitney Co., Hartford, Conn.**, initiated a research program with the ultimate object in view of developing a plug and ring gage material which, in combination with a suitable heat-treatment and a special finishing process, would result in an appreciable lengthening of the life of such gages. The special finishing process referred to is a development of the lapping process used in the manufacture of P. & W. precision gages. The results of this research have recently been announced and are incorporated in the D. L. process gages now being introduced to the trade by this company.

These gages are made from a special alloy steel. The maker states that tests conducted with them in plants of some of the largest producers of automobile and other parts, have shown the gages to have a life as high as six times that of an ordinary steel gage. In one middle western plant, the plug gage previously used in a certain operation could be used for inspecting from 4800 to 5000 holes. A D. L. plug gage used for this inspection had not been worn down to the rejection limit after checking 23,900 holes.

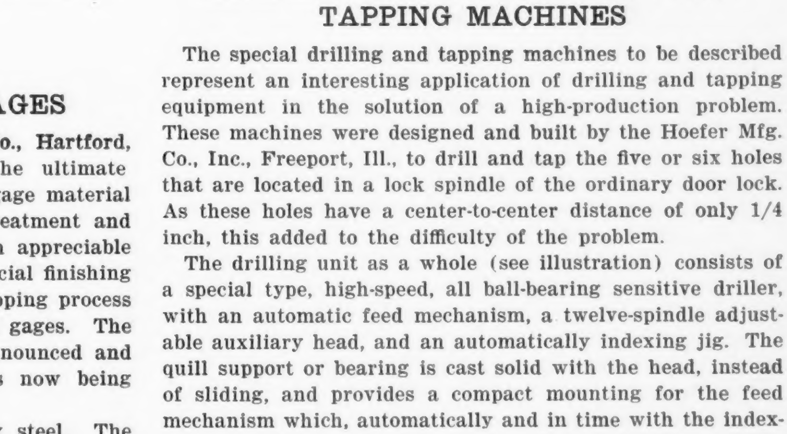
SIDNEY ALL-GEARED HEAVY-DUTY ENGINE LATHE

A new all-geared heavy-duty engine lathe is being placed on the market by the Sidney Machine Tool Co., Sidney, Ohio, in which all speed changes are made through a simplified single-lever control on the headstock. Eight spindle speeds are obtainable, and shifts are made entirely through clutches, at least four headstock gears being in mesh all the time. The single lever can be operated in either direction.

The spindle speeds range from 12 to 317 revolutions per minute, and it is possible to shift from a low speed to a higher speed—for example, to change from 12 to 75 revolutions per minute. It is also possible to operate the lever in the opposite direction to shift from a high speed to a lower one. The eight speeds obtainable are clearly marked on a dial plate attached to the control lever, and are obtained instantaneously by turning the lever to the desired speed, as indicated on the plate. All speeds are obtained with the spindle in motion. The construction of the headstock is claimed to insure free and clean cutting and the elimination of any tool marks on the work in finish-turning. All headstock gears are of the stub type, heat-treated, hardened, and ground.

The drive shaft, back-gear shaft, and all thrust bearings in the headstock are equipped with S K F ball bearings. While the splash system of lubrication is used, lubrication is further guaranteed by a force-feed system in which a pump, driven from the drive shaft of the headstock, delivers 10 1/2 gallons of lubricant per hour. An oil strainer and purifier are provided in the headstock to keep the oil free from foreign matter.

Other important features consist of a new tailstock and bed design. The apron control lever is connected with the control lever on top of the headstock which operates the multiple disk driving clutch. These two control levers, as well as the speed-changing lever on the headstock, when in the neutral positions, brake the spindle. The machine is at present built in two sizes, of 18- and 20-inch swing, respectively, with a bed 8 feet long. This machine is covered by patents.



Sidney Engine Lathe with Single-lever Speed Control

HOEFER MULTIPLE DRILLING AND TAPPING MACHINES

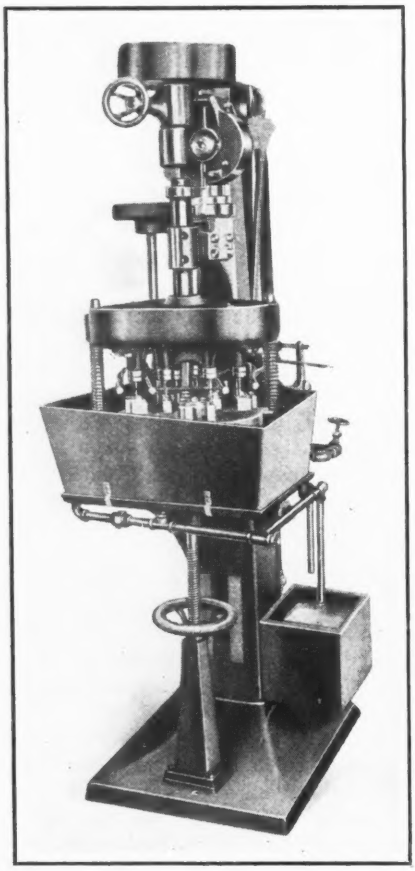
The special drilling and tapping machines to be described represent an interesting application of drilling and tapping equipment in the solution of a high-production problem. These machines were designed and built by the Hoefer Mfg. Co., Inc., Freeport, Ill., to drill and tap the five or six holes that are located in a lock spindle of the ordinary door lock. As these holes have a center-to-center distance of only 1/4 inch, this added to the difficulty of the problem.

The drilling unit as a whole (see illustration) consists of a special type, high-speed, all ball-bearing sensitive driller, with an automatic feed mechanism, a twelve-spindle adjustable auxiliary head, and an automatically indexing jig. The quill support or bearing is cast solid with the head, instead of sliding, and provides a compact mounting for the feed mechanism which, automatically and in time with the indexing of the jig, feeds downward and returns the auxiliary head in a continuous cycle. The feed mechanism is driven from the main pulley on the spindle through worm-gearing, consisting of a hardened steel worm and a bronze worm-gear. On the shaft on which the worm-gear is located is a hardened clutch, by means of which the operator can start or stop the continuous cycle of feeding at any time. The lever is placed in a convenient position for the operator.

A cam of the built-up section type, with rapid approach, feed, quick return and dwell, controls the various functions of drilling, indexing, etc. The cycle of the cam, in this par-

ticular case, is 12 seconds, so that ample time is allowed for the various operations. The auxiliary head has three groups of four spindles each. Only two holes are drilled in two lock spindles in each of the three drilling positions, because of the close spacing of the holes, but six holes are drilled at each indexing. The fourth position is used for loading. The head was made adjustable to accommodate different lengths of lock spindles.

In order to maintain the alignment of the head and jig, these two units are tied together by means of heavy guide rods on which springs are placed that act as a cushion and counterbalance for the head. The jig consists of a hollow base in which are located the gears and the Geneva movement for the indexing, a cover, and a rotating table. The indexing table carries four fixtures, each holding two lock spindles. These fixtures are of steel, hardened, and have a fixed end, so that all holes are properly located from one end. One fixture is always in the loading position. When in this position, a cam beneath the table is in contact with the clamping mechanism for the lock spindles, so that the operator is not concerned with locking or unlocking of the pieces in the jig. A guide bushing plate having guide bushings for each drill is carried on the head. There are also provided V-blocks which raise and lower with the head, and these assure the proper location of the lock spindles.



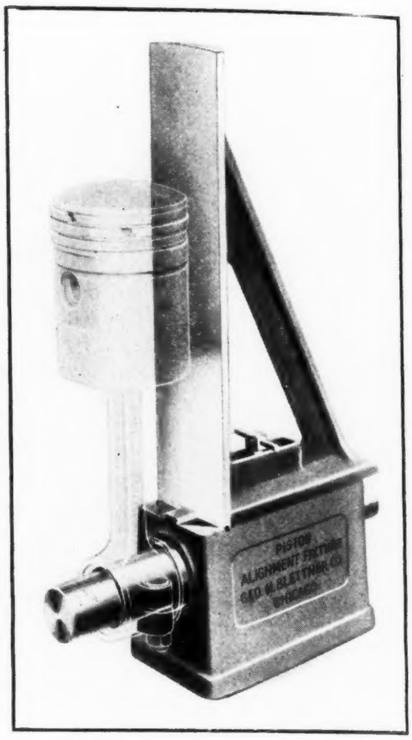
Hoefer Multiple Drilling Machine

The speed of the machine is 1200 revolutions per minute, with an increase in the head to permit running the drills at 2000 revolutions per minute. With 0.004 inch feed on the drills, the production was at the rate of 600 pieces per hour with one operator. Ample lubrication, delivered directly to the drills, is provided by a large geared pump.

The tapping machine is identical with the drilling machine described, except for the addition of the tap reversing mechanism within the head and a cam of slightly different profile. The cam is such that the taps are started with the proper lead, but slow down somewhat to allow them to float in advance of the head. This float is accomplished by built-in floating spindles and tap-holders; these not only float vertically but have a limited side float. The reversing trip is arranged to take place the instant the head reaches the bottom of the cam profile, which is such that the head withdraws in advance of the lead, utilizing the float in the spindles for compensation.

"SQUAROD" PISTON ALIGNMENT FIXTURE

A device for aligning automobile pistons and straightening connecting-rods has recently been brought out by the George H. Blettner Co., 1841 W. Jackson Blvd., Chicago, Ill. This device is provided with a movable "square," which consists of the vertical surface of a slide which may be moved back and forth on the horizontal top of the base. The connecting-rod of a piston and connecting-rod assembly is mounted on an arbor in the base, arbors of various diameters being made to suit different assemblies. The "square" may be slid back out of the way, or brought forward into contact with the work as shown, for guidance or inspection. The fixture occupies a bench space of 5 by 8 inches, and is 20 inches high.

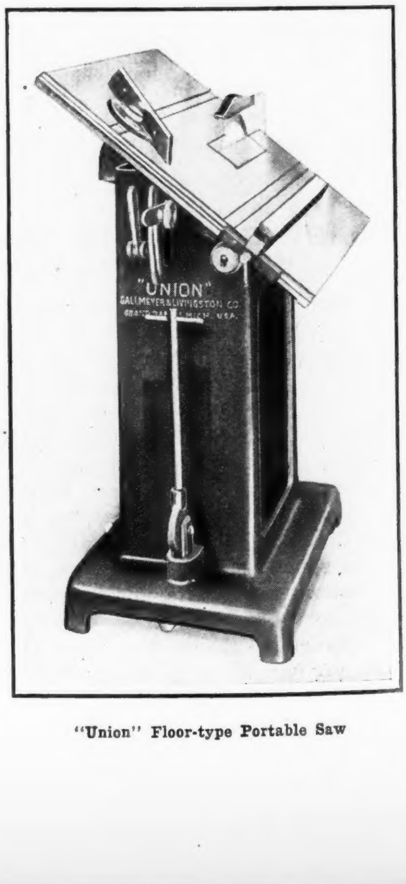


Piston Alignment Fixture

"UNION" PORTABLE UNIVERSAL SAW

The latest pattern-shop machine to be added to the "Union" line of products manufactured by the Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich., consists of a floor-type of portable universal saw. This machine possesses the advantages of a bench machine and, in addition, the cast-iron pedestal provides rigidity. Two rollers at the back of the pedestal and two stationary feet at the front give a firm setting on the floor when the machine is to be used in an operation. As the handle is pulled forward into position for transporting the machine, a cam automatically raises the feet from the floor and brings the weight of the front of the machine on a third roller that is carried on a swivel bearing which moves with the handle. The motor and all working parts are built into the upper portion of the machine, giving a self-contained outfit. The upper part of the machine can be removed from the pedestal and used as a bench type of machine, should the occasion demand.

Either a 1/2-horsepower repulsion induction type of motor operating from a lamp socket or a 1-horsepower repulsion induction type of motor operating from a power line can be furnished. When equipped with a power-line motor and an 8-inch diameter saw, the machine will handle stock up to 12 inches wide by 2 1/2 inches thick. A switch for start-



"Union" Floor-type Portable Saw

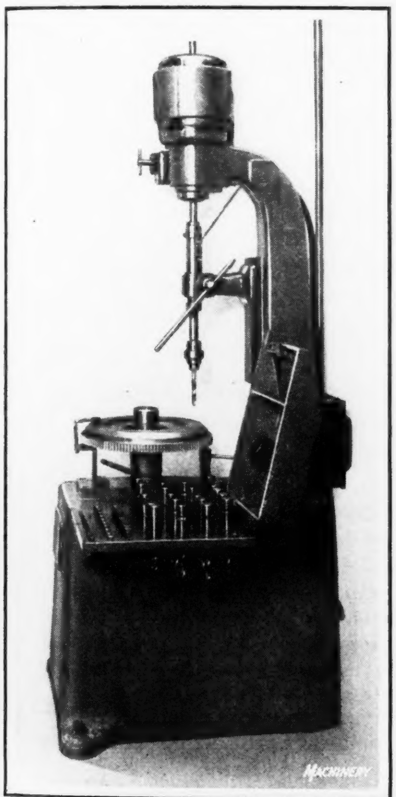
ing and stopping the machine is conveniently placed at the front, so that there is no temptation for the operator to let the machine run unnecessarily.

The table is a solid one-piece casting, measuring 25 by 26 inches, and it is fitted with a removable throat plate to permit the use of dado heads, cope heads, grooving saws, etc. The saw can be raised to a height of 2 1/2 inches above the table. The table may be tilted up to 45 degrees, and locked in any setting. Guards protect the saw at all times, and a splitter guard constitutes part of the safety equipment.

A cross-cut gage can be used on either side of the saw, two slots being provided in the table for this purpose. The gage can be quickly set at any angle and clamped rigidly. Holes are provided for mounting an auxiliary wooden-faced piece. The ripping gage is machined on both sides, and can also be used on either side of the saw. Tightening the lever-head screws locks the ripping gage in position and automatically lines it up with the saw.

"MICRO-POISE" BALANCING MACHINE

A precision machine designed for balancing flywheels, pulleys, and other rotating parts having a comparatively short axis, is being placed on the market by the Commerce Machine Co., 2211 Grand River Ave., Detroit, Mich. It is stated that, with this "Micro-Poise" machine, parts can be balanced within a limit of 1/4 ounce-inch running balance, and that the machine can be furnished for balancing to an even closer degree of accuracy. Automobile flywheels are tested and corrected in this machine at the rate of from 20 to 25 flywheels per hour.

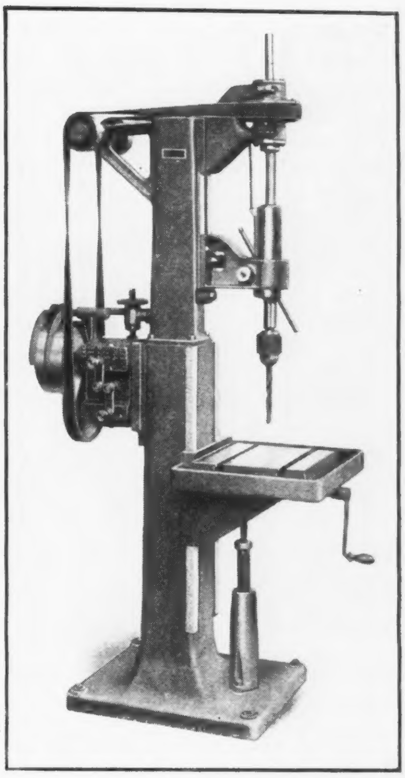


"Micro-Poise" Balancing Machine for Flywheels, Pulleys, etc.

The angular location of unbalance is instantly shown, and the machine is provided with weights that show directly the amount of metal that must be removed from the work to obtain correct balance. For removing excess stock from parts, the machine is equipped with a motor-driven drill spindle. As the machine is not affected by vibration, it can be set up on any floor in any part of a shop.

BERGHAUSEN SENSITIVE DRILLING MACHINE

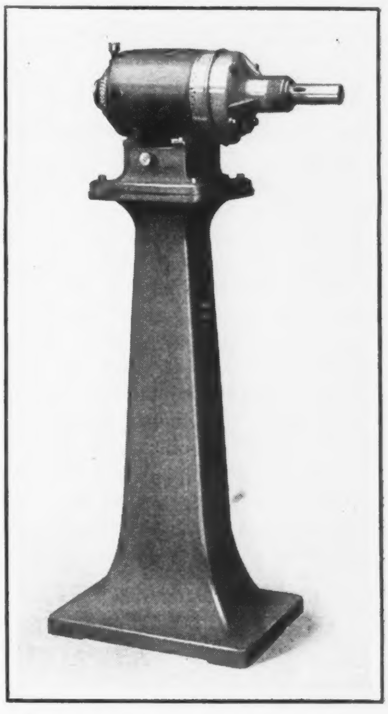
A new sensitive drilling machine is being placed on the market by the Berghausen Machine Co., 2128 Colerain Ave., Cincinnati, Ohio. This machine is provided with ball bearings throughout, except in the loose pulley, where bronze felt-lined bushings are furnished. Altogether, fourteen ball bearings are incorporated in the construction of this machine. The drive is through steel gears running in oil, and by belt over a set of idler pulleys to the spindle pulley. An endless belt can be used, and the gear-box may be raised or lowered through a screw adjustment. Nine speeds of from 250 to 2100 revolutions per minute are obtainable by shifting gears according to the directions on two plates. The shifting of a belt for obtaining speeds is thus eliminated.


Berghausen Sensitive Drilling Machine

The spindle nose has a No. 2 Morse taper fit, and the spindle is accurately ground and balanced. The table measures 20 by 24 inches, and is provided with two T-slots for clamping jigs, vises, etc., in place. The table is raised and lowered by means of a telescopic screw, and can be clamped at any desired height through the action of a screw and taper gib. The distance from the center of the spindle to the face of the column is 8 inches; the vertical adjustment of the head, 7 inches; the vertical adjustment of the table, 22 inches; and the maximum distance from the nose of the spindle to the top of the table, 30 inches. The weight of the machine is about 635 pounds.

CINCINNATI ELECTRIC "SPEED LATHE"

Burring, reaming, countersinking, filing, polishing, and lapping operations on small parts can be conveniently performed by means of a motor-driven "speed lathe" recently added to the line of products manufactured by the Cincinnati Electrical Tool Co., Madison and Edwards Roads, Le Blond Bldg., Cincinnati, Ohio. This machine is of particular value in automobile plants, although it is applicable to any shop. The standard speed of the machine is 900 revolutions per minute, but speeds from 90 to 3400 revolutions per minute can be furnished. At a speed of 90 revolutions per minute, the machine is intended for such work as reaming piston-pin holes, burring hinge rods, and fitting piston-pins to connecting-rods. For finish-reaming babbitt bearings, the recommended speed is 300 revolutions per min-

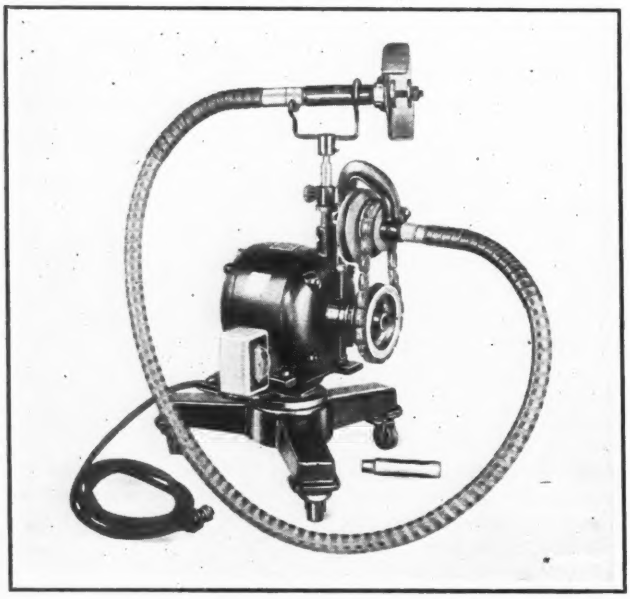

"Speed Lathe" built by the Cincinnati Electrical Tool Co.

ute, while the speed of 900 revolutions per minute is intended for such operations as reaming babbitt from bolt holes, removing excess tin from connecting-rods, and burring and chamfering bolt holes.

The machine is driven by a 1/2-horsepower motor which may be furnished for alternating or direct current. The armature and all gears are mounted in ball bearings, and a ball thrust bearing is also provided. The spindle has a No. 2 Morse taper socket. A table provided with a micrometer screw adjustment can be furnished, and the machine can also be fitted with a multiple-spindle head. As illustrated, the machine weighs about 135 pounds.

HASKINS FLEXIBLE-SHAFT EQUIPMENT BASE

Several improvements have been incorporated in the H-6 caster base model manufactured by the R. G. Haskins Co., 3452 Lake St., Chicago, Ill., for use with flexible shaft equipment. Formerly this was made with a solid wood base, but now it is furnished with a low-pedestal, three-leg, cast-iron base. There is an added weight of 25 pounds, which is advantageous in that it provides more stability for the machine while in operation. The additional weight, however, does not interfere with moving the equipment from one job to another, since the base is provided with ball-bearing casters.

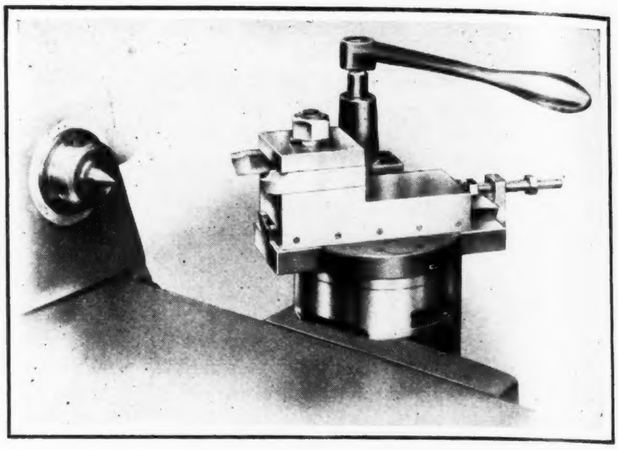


Haskins Cast-iron Caster Base for Flexible-shaft Equipment

The tendency on the part of an operator to use the cable of such equipment as a rope with which to pull the equipment about the shop has often broken or impaired the power connection and put the machine temporarily out of service. For this reason, a new method is used for anchoring the cable and the plug, and the trouble mentioned has been eliminated. Another feature is the new type of armored casing used for the flexible shaft. This casing permits bending the shaft to a small radius without breaking it, and it is oilproof. Armored steel reinforcing is used at both ends. The H-6 equipment now turns around a full 360 degrees to allow greater freedom for the operator than formerly. It is also provided with a new type of switch box. The motor is of 1/2-horsepower capacity, and drives the shaft at a maximum speed of 3600 revolutions per minute.

PORTER-CABLE ANGULAR FACING ATTACHMENT

The latest development of the Porter-Cable Machine Co., N. Salina and Exchange Sts., Syracuse, N. Y., is an angular facing attachment designed for application to the "Hi-Speed" production lathes built by this concern. This device is mounted on the tailstock ways, and may be moved into any position along the bed. A swivel feature permits the tool to be turned at any angle to the work and the tool may be fed in by hand at the desired speed. The depth of cut is regulated by means of an adjustable stop, while the position of the attachment along the ways and the angle at which the cutters are set are maintained by clamping screws.



Porter-Cable Lathe Attachment for machining Angular Surfaces

An open type of tool-holder is mounted on the carriage, and the latter slides forward and backward on the dovetail ways of a swivel plate through the action of a rack and pinion, when the handle is turned. The swivel plate may be turned in any direction and clamped in any desired position. In addition to its application in such angular operations as facing gear blanks, this attachment is particularly useful for chamfering and necking work before or after turning operations. It has the advantage of insuring that just the desired amount of pressure is exerted against parts held on an arbor.

PORTABLE TAPPER, DIE GRINDER AND DRILL

Recent additions to the line of portable tools manufactured by the United States Electrical Tool Co., 2488-2496 W. Sixth St., Cincinnati, Ohio, include a tapper, die grinder, and 1/4-inch heavy-duty drill. The tapper is manufactured in two sizes—Nos. 1 and 2—and is of the design illustrated at *A*, Fig. 1. This tool operates on direct and alternating electrical current, and is provided with a mechanism that reverses the chuck automatically when the tool is pulled backward. The clutch has a positive engagement during

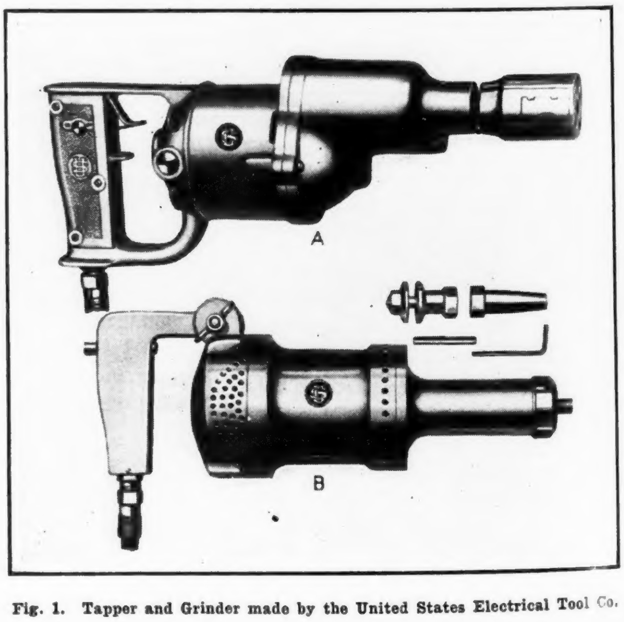


Fig. 1. Tapper and Grinder made by the United States Electrical Tool Co.

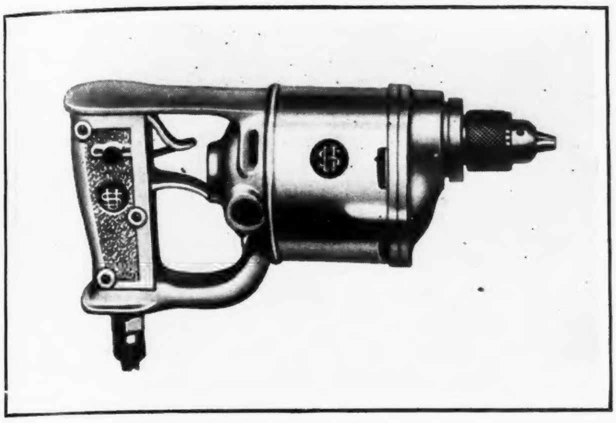


Fig. 2. Heavy-duty Portable Electric Drill

tapping operations. In withdrawing a tap, the drive is through a friction clutch, which obviates tap breakage.

The grinder is shown at *B*, Fig. 1, and is especially adapted for grinding dies, welded parts, and fins of light castings. The adjustable back handle permits operation of the tool in close places. The grinder has a load speed of 11,000 revolutions per minute, and weighs 12 pounds.

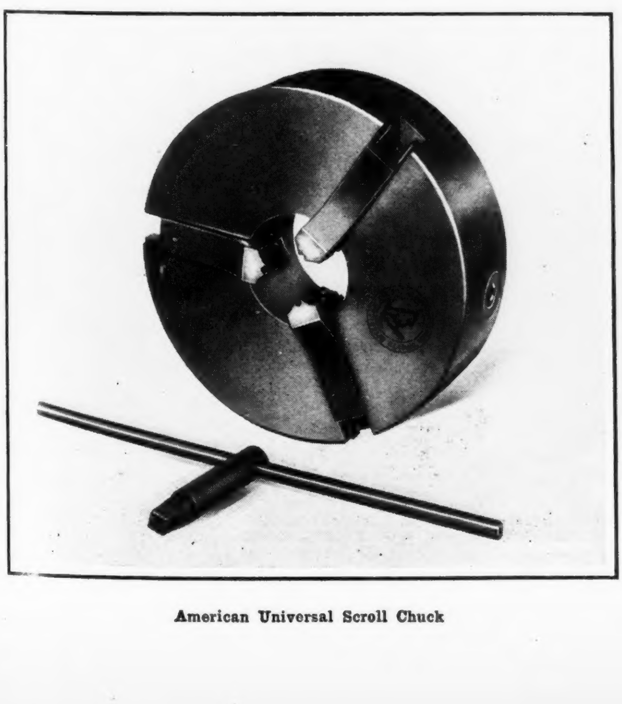
Fig. 2 shows the 1/4-inch heavy-duty drill. This device is equipped with four S K F ball bearings which are mounted in steel castings. The bearings are placed in front and back of the spindle to compensate for in and out thrusts. The drill is furnished with a universal motor and has a speed of 2000 revolutions per minute under load. It weighs 6 pounds.

NEW MODEL OF SIMBI HAMMERS

A new Simbi hammer known as model 26, has been placed on the market. The new model, like the old one, is manufactured in four types, and is distributed by the Rawlplug Co., Inc., 66 West Broadway, New York City. The chief characteristics of the new model are its increased efficiency and much higher drilling capacity.

AMERICAN UNIVERSAL SCROLL CHUCK

A 9-inch universal scroll chuck, of the construction shown in the accompanying illustration, constitutes the first series of a line of chucks that the American Die & Tool Co., Reading, Pa., plans to place on the market. The body is an iron casting that is well reinforced in the sections subjected to stresses. Three hardened tool-steel jaws are provided, and these are adjusted radially by means of a scroll and pinions that are made of a heat-treated steel. The distance from the face of the chuck to the end of the spindle is 3 1/4 inches, and the chuck diameter is 9 inches. The weight of the chuck is 38 pounds.



American Universal Scroll Chuck

ELWELL-PARKER ELECTRIC LIFT "TRUCTOR"

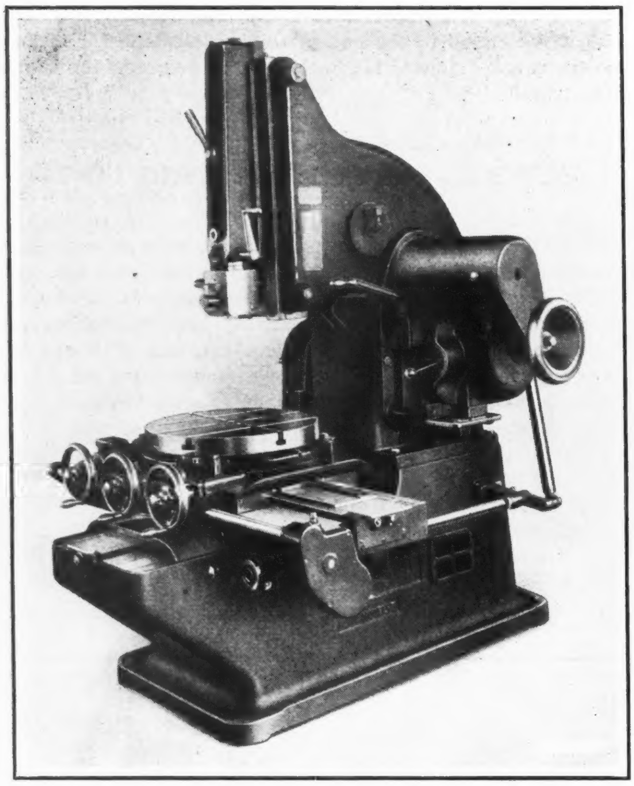
Loads of 20,000 pounds can be picked up and set down electrically by means of the latest "tructor" brought out by the Elwell-Parker Electric Co., Cleveland, Ohio. As on other "tructors" built by this company, the lift mechanism is located beneath the battery, and consists of a special motor which is direct-connected to a single-worm reduction having a nut built into the hub of the worm-wheel. A forged multiple-thread worm or screw lift ram travels in and out of this nut to lift or lower the all-steel reinforced platform. This platform is supported by two bushed rockers or links on main center sills at the battery end, and by a large H-link beneath the forward end.

The tandem trail axle carries four wheels, each of which is fitted with two differentiating tires to provide proper creep when they are steered. All four of these wheels are steered simultaneously and concentrically with the two larger drive wheels located beneath the battery. The four wheels have solid rubber tires and carry the bulk of the load. Each of them is equipped with two heavy tapered roller bearings. The steering rods from both axles terminate at the foot of the steering post. Steering is accomplished by means of a handwheel, a reduction being obtained through miter gears and worm-gears supported on radial or thrust ball bearings. The lift motor is equipped with an electro-mechanical brake. This "tructor" carries more than three times its weight, and travels at the rate of from 300 to 400 feet per minute.

Elwell-Parker Lift "Tructor" carrying a Large Machine

PRATT & WHITNEY VERTICAL SHAPER

A 12-inch vertical shaper of new design has been placed on the market by the Pratt & Whitney Co., Hartford, Conn., to replace the old 10-inch model built by this company. Operating convenience and a wide range of speeds and feeds are the principal features of the new model. The three operating handwheels are located at the front of the machine, and the feed reverse lever and friction clutch levers are also



Pratt & Whitney Vertical Shaper which replaces Previous Model

within easy reach of the operator. Hence, he has complete control of the machine without moving from the front.

Either a built-in motor drive or a single-pulley belt drive from a lineshaft can be provided. In either case, the main drive pulley rotates at a constant speed of 440 revolutions per minute, regardless of the cutting speed. When arranged with an individual motor drive, a five-horsepower constant-speed motor is mounted inside the bed, with the result that the floor space required for both motor- and belt-driven machines is the same. It is a simple matter to change from one type of drive to another at any time.

Delivery of power to the machine proper is controlled by means of the friction clutch, which is incorporated in the drive pulley. A lever for operating this clutch is mounted on each side of the ram, these levers having three positions—namely, a working position, a neutral position, and a position in which a brake is applied to stop the ram quickly. The brake permits of drifting the ram into position for starting a cut and then holding it there. The friction clutch levers also actuate a safety interlock to prevent changing the speed gears while they are in motion.

Four speeds are obtainable through the gear-box on the right-hand side of the machine. An H-type shift lever provides a convenient means of controlling the feeds. The construction of the gear-box is comparable to the transmission of an automobile. Power is delivered from the gear-box to the vertical ram by means of a large slotted eccentric and a follower block, which produce the slow power stroke and the quick return motion. The ram is counterbalanced, and all the mechanism is enclosed to keep it clean and prevent accidents.

The ram slide and ram form a separate unit on the front of the column. The slide is hinged at the top, and has a screw adjustment at the bottom which permits the entire unit to be swung to any angle up to 5 degrees and locked solidly in position. This construction facilitates machining the angular sides of dies, and an angular scale permits settings to be made with ease. A new feature is that the ram may be returned to its true vertical position without any additional adjustment.

A handwheel on the gear-box provides for easily moving the ram through the entire length of its travel in order to position it at the beginning of a cut. The vertical position of the ram on the slide is effected by turning a crank, while a binder handle is used to lock the ram in position. The length of the ram stroke is variable from 0 to 12 inches, and four speeds of 22, 37, 56, and 90 strokes per minute are obtained through the gear-box.

The toolpost is carried in a clapper, so mounted that the thrust of the cut forces it rigidly against the head. Attention is called to the elimination of the toolpost binder screw, the tool being held by drawing the toolpost against it from the back. This feature permits the toolpost to pass over the work without interference, as in no case does it project beyond the cutting edge of the tool. The tool-head may be rotated a full 360 degrees and clamped in any position.

Power feed for the entire machine is obtained through a cam located on the upper right-hand side of the column. This cam is driven by an extension of a shaft from the speed gear-box, and is always in the correct relation with the speed of the ram. A cam follower actuates a bellcrank which supplies the feed through a rocker motion at the end of each stroke. The lever that connects the bellcrank with the feed-gear rod is adjustable to permit varying the amount of feed. This lever constitutes a safety device that prevents damage to the machine should the work or tool become jammed. The feed gear-box provides a forward, neutral, and reverse feed drive, and is controlled by means of a knob on the front of the bed. The carriage is equipped with a 24-inch rotary table. This table has a longitudinal movement of 25 inches on the carriage, while the carriage has a transverse movement of similar length on the bed. Provided with the regular equipment, this machine weighs about 7500 pounds.

LANDIS PIPE-THREADING AND CUTTING-OFF MACHINE

A 4-inch size has been added to the new line of pipe-threading and cutting-off machines built by the Landis Machine Co., Inc., Waynesboro, Pa. This machine is designed for jobbers of pipe and plumbing supplies, contractors, oil fields, and railroad and other shops where pipe must be threaded and cut off. The machine is equipped with a base of different design from that provided on the other sizes. The new outline of the bed offers ample support for the headstock and carriage. The single pulley drive may be readily converted into a motor drive, as shown in Fig. 2. A reversing mechanism is contained in the gear-box and operated by means of a lever conveniently located. This reversing mechanism eliminates the necessity of crossing the belt or throwing a switch when the machine is to be reversed.

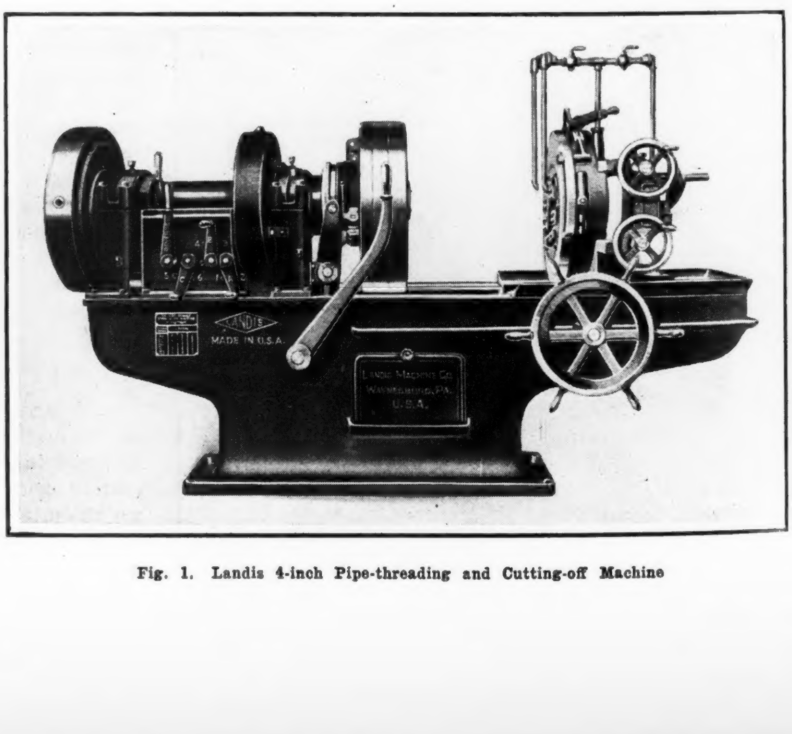


Fig. 1. Landis 4-inch Pipe-threading and Cutting-off Machine

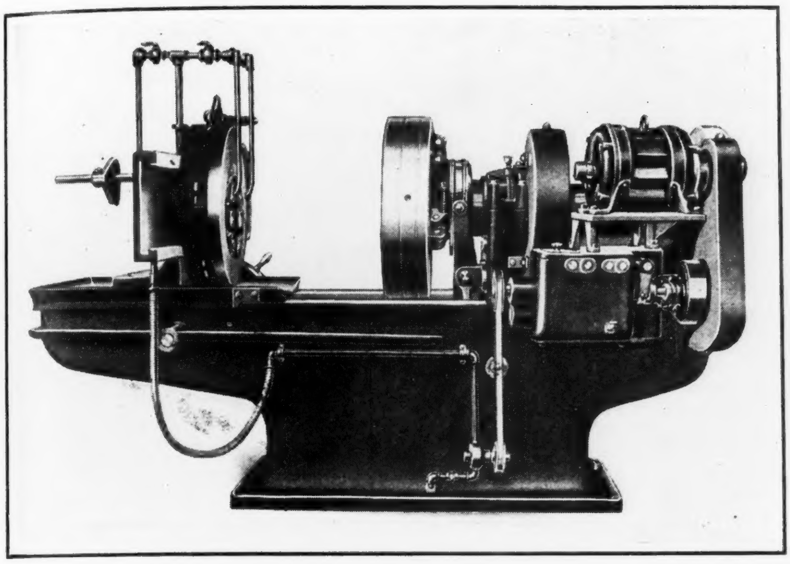


Fig. 2. Arrangement of Motor Drive and Gear-box on New Landis Machine

The starting and stopping levers, as well as the levers used for obtaining the various speeds, are also located on the operating side of the machine.

The front and rear chucks are of the three-jaw type and of sturdy construction. The front chuck has a universal adjustment and is lever-operated to permit pipe to be put in and taken out without stopping the machine. An independent adjustment is furnished for the rear chuck. The main spindle of the machine is supported by two distinct bearings which are lubricated by flat link chains running in an oil reservoir.

The carriage supports the cross-rail on which are located the die-heads, centering jaws, cutting-off tools, and reaming tool. Two cutting-off tools are employed, and these are located diametrically opposite each other in holders that have a universal movement to and from the center. There is also a horizontal adjustment for these holders which provides for centering the tools. The reaming device is attached to the cutting-off tool-slide, and is lever-operated.

From 1- to 4-inch pipe may be handled in this machine, and the range is covered by two Landis stationary pipe die-heads. A 2-inch head covers the range from 1- to 2-inch pipe, and a 4-inch head the range from 2 1/2- to 4-inch pipe. The die-heads float horizontally on the cross-rail. The cutting solution system includes a rotary pump, a by-pass valve for the surplus solution, and control valves which are located at the die-head and cutting-off tools. Eight speeds are provided for the machine. The travel of the carriage is 24 inches, and the floor space required, 4 feet 5 1/4 inches by 8 feet 6 inches. The belt-driven machine weighs 5700 pounds, and the motor-driven machine, 6300 pounds.

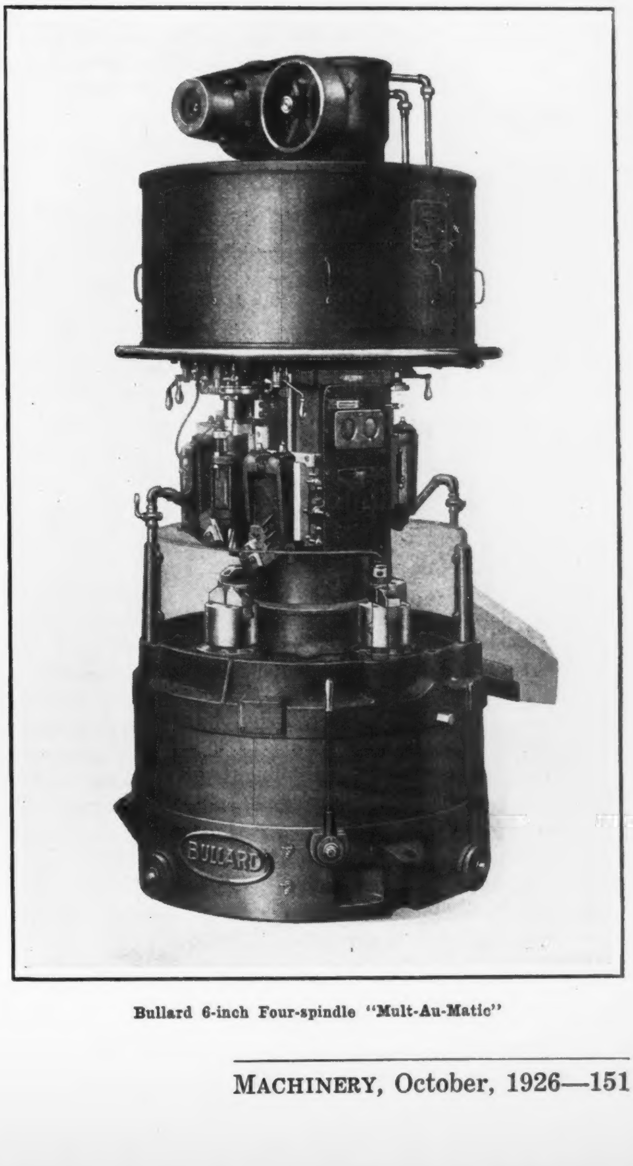
BULLARD "MULT-AU-MATIC"

A 6-inch, four-spindle "Mult-Au-Matic" has been brought out by the Bullard Machine Tool Co., Bridgeport, Conn. In general design, this machine is similar to the previous model described in February, 1925, MACHINERY, but it is only 8 feet 8 inches high over all, and is contained within a floor space 4 feet in diameter. In brief, the machine comprises a heavy circular base casting, which contains reservoirs and pumps for both lubricating oil and cutting compound. Rising from this base is a central column, the lower portion of which provides a tapered cylindrical bearing for the carrier. The upper portion is square, and on three faces are mounted the tool-heads and ways. The fourth face is equipped with a door, making the mechanism within accessible.

The compartment immediately above the base contains the carrier indexing arm, spindle drive gears, and the chuck-operating mechanism. This compartment is covered by the work-spindle carrier itself. The carrier supports four spindles equally spaced about the central column, which, with the tool-heads mounted on the column faces above, provide one loading station and three machining stations. Mounted at the head of the central column, and overhanging the tool-heads and spindles, is the feed works for each of the three machining stations, and also the multiple disk clutch and upper portion of the central controlling mechanism. The cover of the feed works compartment comprises a distributing reservoir for lubricating oil, which floods all operating parts while the machine is in motion. The cover also provides a platform for the drive bracket and upper oil-reservoir unit, as well as a mounting for the motor.

A feature of this "Mult-Au-Matic" is the power chucking device, which consists of a mechanism at the loading station that connects with each spindle as the spindle is presented for unloading and loading work. By throwing the operating lever in either direction, the work is respectively released or gripped, and the force exerted on the lever does not affect the chucking pressure. The device is suitable for operating standard or special chucks, and is adaptable to several designs of special work-holding fixtures. Power for operating the chuck is derived from the same source as the power for the machine itself, and the holding force, when the jaws are once set, does not depend upon constant connection with the source of power. The jaw pressure may be set to suit the particular job in process.

Tool-heads of the plain vertical, compound horizontal, standard universal, and double-purpose types may be provided at the three machining stations. Work 10 inches in diameter up to 5 inches high can be handled, and 6 1/2



Bullard 6-inch Four-spindle "Mult-Au-Matic"

inches in diameter up to 7 1/2 inches high. Spindle speeds may range from 30 to 480 revolutions per minute, and tool feeds from 0.003 to 0.114 inch per spindle revolution. This machine is intended to handle the smaller pieces for which the greater capacity of the larger "Mult-Au-Matics" is not required.

AVEY MILBAND CUTTING-OFF MACHINE

A cutting-off machine designed for the rapid and accurate cutting off of bar stock up to 6 1/2 inches in diameter is being manufactured and sold by the Avey Drilling Machine Co., Inc., Cincinnati, Ohio, under exclusive license from the Henry G. Thompson & Son Co., New Haven, Conn. This machine operates on the principle of the milling cut, whereby each tooth of the band blade does its predetermined share of the cutting. This is accomplished by means of a positive continuous feed selected to suit the size of the work and the material. With this positive feed, every cut for a given size and material is made in the same time, whether it is the first cut or the last one, before discarding the band blade. The feed mechanism is built into the bed of the machine, and there are eighteen selective feeds.

Three blade speeds are available from one lever operating sliding gears. The gear shafts are mounted on radial type ball bearings. The flanged band wheels are also ball-bearing mounted, and the idle wheel has self-aligning bearings with adjustment to facilitate tracking the band. Guide rolls with easy adjustment to maintain true guiding action on the saw are rigidly attached to the arm on both sides of the cut. These are tool steel, hardened and ground rolls, with ball bearing mountings.

When the saw blade is advanced to the work by means of the large pilot wheel seen in the illustrations, the feed engages automatically. At the end of the cut, the feed is automatically disengaged, and the saw arm returns to its highest position. Fig. 1 shows the saw elevated, and the rear view, Fig. 2, shows its position at the end of a cut. Ample flow of coolant is delivered to the blade by a B & S geared pump driven from the main shaft. An aluminum self-draining bandsaw guard protects the operator. The work is clamped in a double vise on both sides of the cut, and a rigid adjustable stock stop is furnished for gaging the length of stock to be cut off. The regular machine has tight and loose pulleys with the starting and stopping lever in a convenient position at the front. This machine, however, can be arranged for a belted motor drive attachment if desired.

Fig. 1. Avey Milband Cutting-off Machine

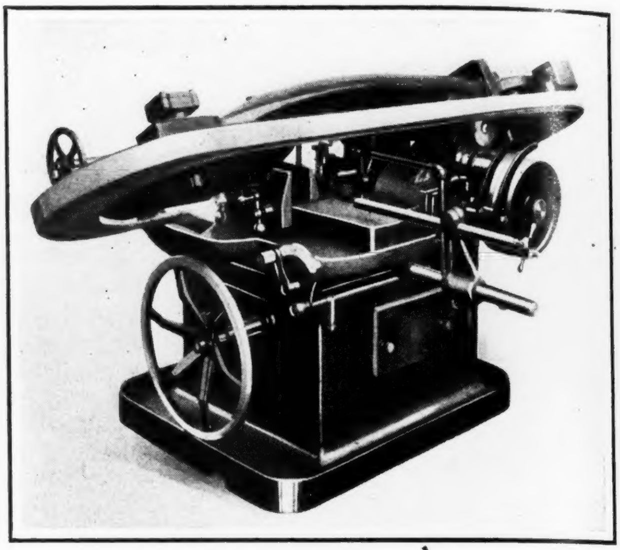


Fig. 2. Rear View of Avey Milband Cutting-off Machine

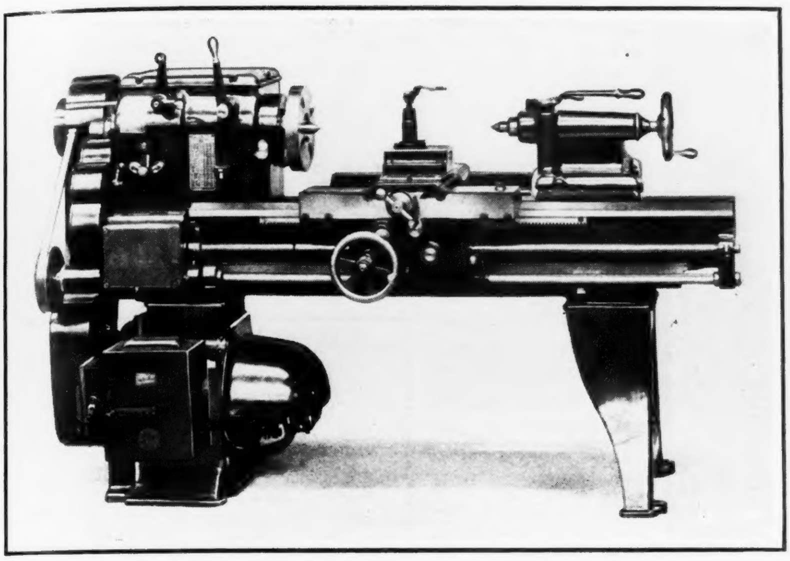
The standard saw speeds, in feet per minute, are as follows: 176 for low-carbon steel, 135 for mild tool steel, and 95 for high-speed and other alloy steels. A general idea of the cutting-off time may be obtained from the following figures based upon a saw speed of 176 feet per minute: Stock 1 inch in diameter, 0.16 minute; stock 2 inches in diameter, 0.55 minute; stock 4 inches in diameter, 3.3 minutes; and stock 6 inches in diameter, 14.15 minutes.

The capacity of the machine is 6 1/2 inches by 6 1/2 inches. The blade size is 1 inch wide by 12 feet 9 inches long; the floor space, 53 by 87 inches, or 32 square feet; and the approximate net weight, 2200 pounds.

LEBLOND "RAPID PRODUCTION" LATHE

A 16-inch geared-head "Rapid Production" lathe is now being built by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, with automatic lubrication throughout. The headstock, feed and traverse mechanism, and apron are all flood-lubricated and, in addition, a submerged geared pump in the apron furnishes automatic forced lubrication to the carriage and cross-slide bearings. Hand-oiling is eliminated, and no attention need be given to lubrication except to see that the proper oil level is maintained in the various units. Another feature of the machine is the use of Timken tapered roller bearings in the selective-speed geared headstock. The spindle, drive shaft, and all intermediate shafts are mounted on bearings of this type. The machine is primarily intended for plain turning and facing operations on quantity-production work. A rapid power traverse to the carriage and cross-slide furnish maximum operating convenience and reduce the handling time and the time between cuts. The feed and the traverse to the carriage and the cross-slide in either direction are controlled through a single lever on the apron.

The drive to the machine is through a multiple-disk clutch in the driving pulley, and then through gear combinations to the spindle. The driving clutch embodies a quick-acting friction brake which is automatically engaged upon the release of the friction to bring the spindle to an instant stop. The friction is controlled by means of a handle on the front of the headstock. Six spindle speeds of from 47 to 450 revolutions per minute are obtainable through two levers.



LeBlond Lathe which is automatically lubricated throughout

The drive for the geared feed mechanism is taken from one of the headstock intermediate shafts and delivered through a quadrant and system of change-gears to the feed shaft. Coarse feed changes are made through change-gears on the quadrant, and the intermediate fine changes by shifting a lever on the front of the headstock. Twenty-seven feeds ranging from 0.003 to 0.108 inch per spindle revolution are available.

The rapid power traverse is incorporated in the feed mechanism, and power is transmitted to the traverse shaft by belt from the driving pulley. The traverse is engaged by a lever on the apron, which shifts a double positive jaw clutch, the traverse being effective both longitudinally for the carriage and transversely for the slide, in either direction. The same lever is also used to engage the longitudinal and cross feeds. The feed and traverse are interlocked so that they cannot be engaged at the same time.

The gearing in the apron is vèry simple, as there are only six gears. All shafts have bearings at the front and rear. The apron handwheel is provided with a positive clutch which can be disengaged so that the handwheel will not revolve while the feed or power traverse is engaged. The bed is of the heavy-duty type with the "compensating vee" construction on the front shear. This construction provides a large carriage bearing area and insures lasting alignment. It furnishes a thrust bearing approximately at right angles to the tool pressure on any diameter of work within the swing of the machine. The tailstock is of the set-over type, and the top is graduated so that the amount of set-over may be accurately determined. It is securely clamped in position on the bed by two heavy bolts.

Either a geared or belted constant-speed motor drive for alternating or direct current may be furnished. In the geared motor drive, the motor is mounted on top of the headstock, while in the belted motor drive, it is housed in the base of the front cabinet leg where it is completely enclosed and out of the way. A five-horsepower motor running at 1200 revolutions per minute is recommended.

FOOTE-BURT MUD-RING AND FLUE-SHEET DRILL

Railroad shop requirements in the building of modern large-type locomotives have been met in the design of the No. 3 mud-ring and flue-sheet drilling machine recently brought out by the Foote-Burt Co., Cleveland, Ohio. This machine is regularly equipped with four No. 30 spindle heads for drilling the rivet holes around firebox mud rings and the flue holes in boiler flue sheets. The long travel of the table and the back-and-forth adjustment of the spindles, as well as the in-and-out spindle adjustment, allow large flue sheets to be drilled in one setting.

The spindles overhang the finished edge of the base so that mud rings can be bolted to this edge by means of three horizontal T-slots. The two outside knees which support the table are fixed, but the three center knees may be adjusted in case they interfere with the clamping of mud rings. In drilling flue sheets, all knees are doweled in position to form bearings for the table. A pit can be placed in the floor, flush with the front finished face of the base, so that mud rings can project down into the pit while being drilled.

Either a belt or motor drive can be provided for this machine. Power is taken by a horizontal shaft and delivered through bevel gears to each head. In each head, the power is transmitted through a vertical shaft and spur gears direct to the spindle. Each head has a drilling capacity of 3 1/2 inches in solid steel, or 7 inches when using a fly cutter. The minimum center distance between two spindles is 24 inches, and the maximum distance between the two outer spindles, 123 inches. The in-and-out adjustment of the spindles is 18 inches. All handwheels for controlling the adjustment of the heads and the spindles are located at the front of the machine within easy reach of the operator.

The heads are independently provided with three quick feed changes. Speed changes are accomplished through a cone pulley and back-gears when the machine is arranged for belt drive, or through a variable-speed motor when a motor drive is provided; hence, the speeds of the spindles cannot be changed independently. The spindle sleeves are made with the double rack cut solid, which is a Foote-Burt patented feature.

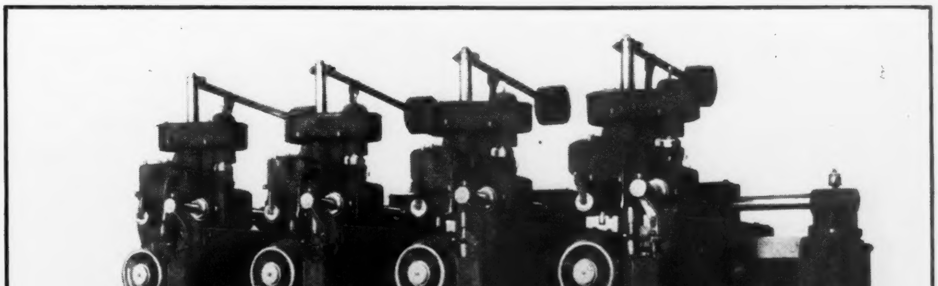


Fig. 1. Foote-Burt Mud-ring and Flue-sheet Drilling Machine developed primarily for Railway Shops

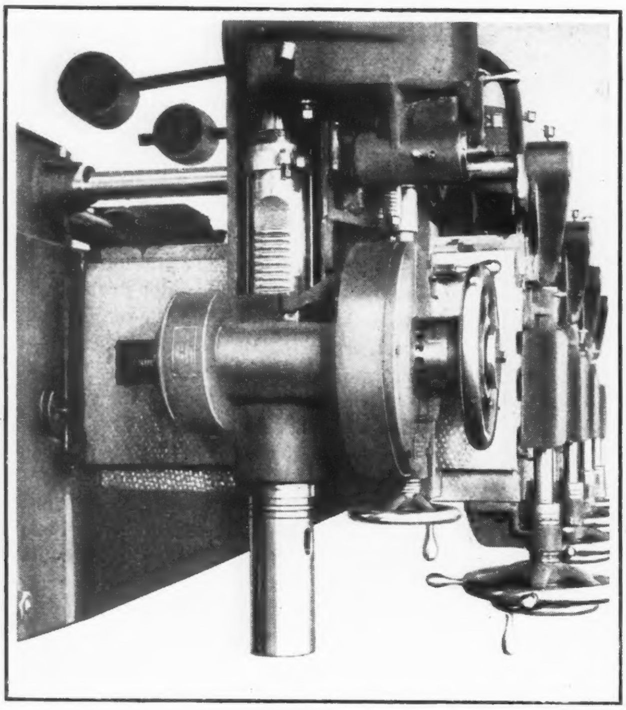
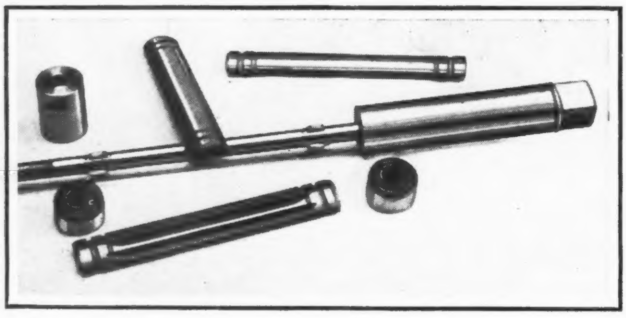


Fig. 2. Manner in which Each Spindle Head is arranged on a Slide to provide for In-and-out Adjustment

With a view to making the machine as rigid as possible, the uprights are securely bolted to the base on an L-shaped pad. The cross-rail on which the heads are mounted is of the box type, and placed in large slots in each of the uprights, where it is securely bolted in three directions. Each head slide is "wrapped" completely around the cross-rail to obtain the maximum amount of bearing surface, and is gibbed. The table has a working surface measuring 75 by 144 inches, and may be adjusted 60 inches in and out. The weight of the machine is approximately 40,000 pounds.

"RED-LINE" SCROLL ADJUSTABLE REAMER

A scroll adjustable-blade reamer of novel design has recently been developed by the Modern Reamer Specialty Co., Millersburg, Pa. This "Red-Line" reamer consists of a body to which three or more blades are attached. The blades are held in place by means of keys fastened to the stem of the body. Adjustments are made by simply turning a scroll collar at either end of the blades. By this method, an unusual range of adjustment is obtained, and it is possible to ream a tapered hole, either front or back tapered.

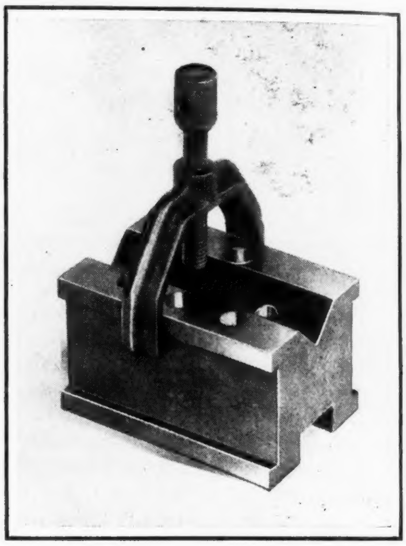


"Red-Line" Reamer adjusted by Means of Scrolls

The range of adjustment varies with the size of the reamer, an adjustment of over 1/4 inch being obtainable on the 1-inch size. This range of adjustment makes possible the elimination of several sizes of reamers that would ordinarily be required to cover a given range of diameters. Another feature claimed for the reamer is that it is possible to regrind the tool a large number of times. While the illustration shows the straight-fluted type, both straight- or spiral-fluted reamers are manufactured. The flutes of the spiral reamer are similar to those of the regular style of "Red-Line" spiral expansion reamers which cut continuously from end to end.

BROWN & SHARPE HANDY BLOCK AND CLAMP

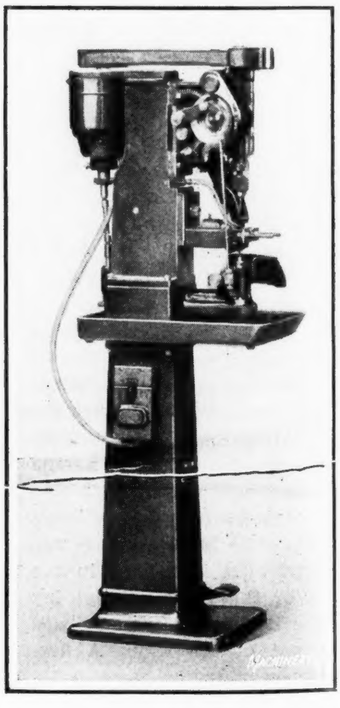
A handy block and clamp No. 751, which may be used as a small V-block, clamp, anvil, or vise, has recently been placed on the market by the Brown & Sharpe Mfg. Co., Providence, R. I. This device consists of a machined and casehardened steel block and a substantial clamp and screw, as shown in the illustration. Small circular or flat pieces can be held in the block while being milled, ground, or drilled. Bent rods can be quickly straightened by the use of this device. The block measures 3 inches long, 2 inches wide, and 1 3/4 inches high.



Brown & Sharpe Handy Block and Clamp

KINGSBURY DRILLING AND BURRING MACHINE

The latest addition to the line of drilling machines built by the Kingsbury Machine Co., Keene, N. H., is a general-purpose vertical type of machine designed for cross-drilling parts and removing burrs at the bottom of the drilled holes. This machine is equipped with the standard drill head previously described in MACHINERY, the No. 82 universal fixture, and the No. 107 burring spindle unit. Blank parts are simply inserted in the fixture, after which the operator depresses a treadle, causing the work to be clamped, drilled, countersunk on the bottom of the hole to remove the burrs, and unclamped. All these movements are obtained automatically in the sequence given, and arrangement can also be made for automatically ejecting the work after it has been unclamped. As many as five of these drilling and burring units may be mounted on one bed. Adjustable V-blocks enable work of various sizes, up to 3/4 inch in diameter, to be held. Interchangeable pulleys provide for spindle speeds up to 7000 revolutions per minute, with the motor running at 3500 revolutions per minute.

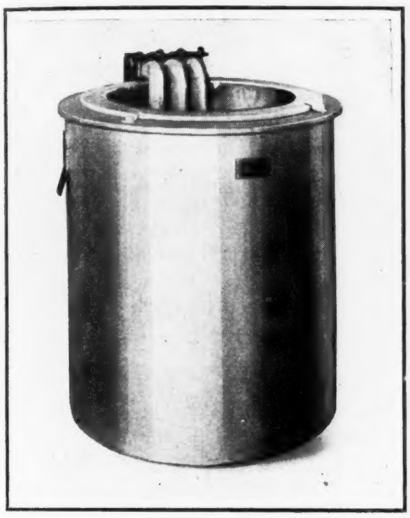


Kingsbury Drilling and Burring Machine

GENERAL ELECTRIC METAL MELTING POT

Approximately 1000 pounds of lead, babbitt, tin, and similar alloys melting at temperatures not exceeding 850 degrees F., can be handled at one time in a melting pot recently added tô the line of products manufactured by the General Electric Co., Schenectady, N. Y. This pot operates on the electric heating principle, and is practically the same as other standard GE melting pots, with the exception that three cast-in sheath-wire immersion heating units are employed, instead of two.

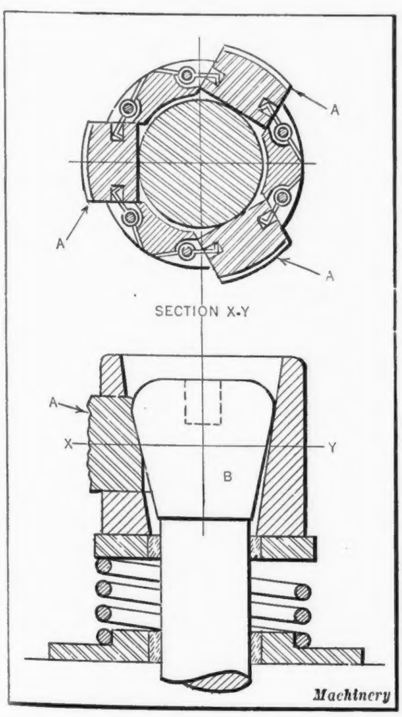
The pot itself consists of a sheet-steel cylindrical casing in which a cast-iron crucible is supported. This crucible has an inside diameter of 18 inches and an inside depth of 15 inches. The outside diameter is 29 inches, and the outside depth, 31 inches. The space between the casing and the crucible measures about 3 inches, and is filled with a compact heat insulator. The leads of the heating units are brought over the top of the pot into a connection box fitted to the unit itself. Full-automatic control is recommended.



General Electric Metal Melting Pot

PNEUMATIC OR HYDRAULIC CHUCK

A work-holding chuck for lathes, boring mills, and other machine tools, which may be operated by air or hydraulically, has been introduced to the trade by the India Machine & Rubber Mold Co., 174 Annadale Ave., Akron, Ohio. The chuck is designed for holding railway car wheels, flywheels, pulleys, gear blanks, and similar parts having a central hole. It consists essentially of a body in which jaws *A* may be operated radially outward to grip work as the center shaft *B* is pulled downward (when the device is mounted on a boring mill). Springs operate on the sides of each jaw to draw the jaw automatically toward the center of the chuck and release the work, when shaft *B* is again pushed upward. When the chuck is mounted on a lathe, the center shaft is pulled toward the left to grip work and pushed toward the right to release it. On one job held by this chuck, seven tools take simultaneous cuts.



Work-holding Chuck which may be operated by Air or hydraulically

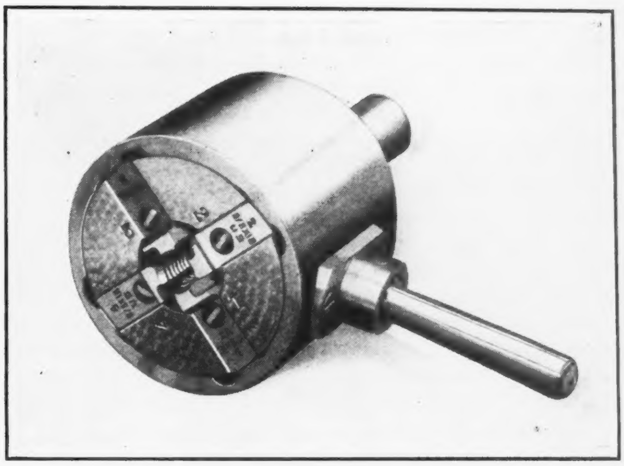


Fig. 1. National-Acme Self-opening Stationary Die-head

NATIONAL-ACME SELF-OPENING DIE-HEAD

The line of self-opening die-heads manufactured by the National Acme Co., Cleveland, Ohio, has recently been revised, and two types of tools are now made to handle every threading need within their capacity. The style R revolving die-head described in February MACHINERY is intended for use in all cases where a live spindle requires a revolving die-head. For operations in which a stationary or hand die-head is necessary, the company has recently brought out the style S die-head here illustrated. This tool can be used for "straight-away" threading, "close-to-shoulder" threading, or for producing short threads. It can be applied to all types of hand screw machines, turret lathes, etc., requiring a stationary die-head. Chasers are interchangeable between the revolving and hand die-heads of the same size, thus necessitating the stocking of only one type of chaser.

One of the principal features of the style S die-head is that it may be rapidly taken apart for cleaning and quickly reassembled. This has been done in less than two minutes. It is merely necessary to remove two screws and then, while the handle is held, the body and shank will slide out of the cup or hood. After cleaning, the die-head can be reassembled without affecting the size adjustment. Another feature is that the shank rides on coil springs, so placed that when the thread has been cut to the desired length and the chasers have been automatically thrown open, the springs pull the chasers away from the work. This makes it possible to thread close to shoulders and to cut short threads accurately.

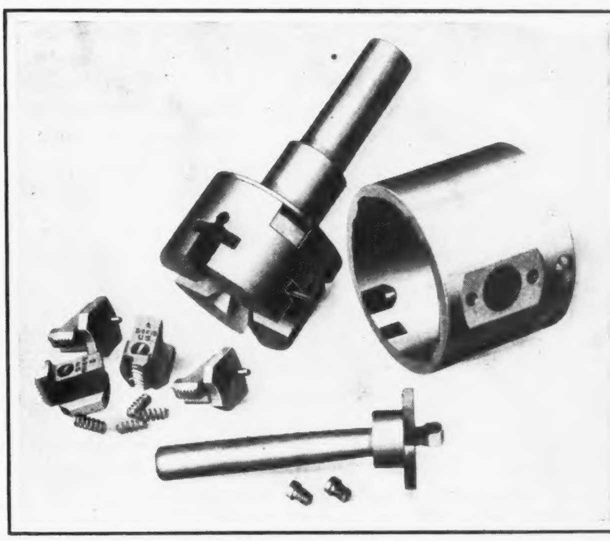


Fig. 2. View of the Disassembled Die-head Parts

Size adjustments can be quickly made by means of a screwdriver without removing the die-head from its holder. The adjusting screws are located in the periphery of the cup, and

the adjusting ring is graduated to facilitate settings. Seven sizes of the style S die-head are manufactured for cutting threads from 1/8 to 2 1/2 inches in diameter.

* * *

NEW MACHINERY AND TOOLS NOTES

Wrench Set: Bonney Forge & Tool Works, Allentown, Pa. A set of thirty carbon-steel wrenches of a wide range of sizes and types, intended for use in general repair work or by a mechanic requiring a complete assortment. Included in this No. 650 set are double-end engineers' wrenches for U. S. standard and S.A.E. nuts and cap-screws; valve tappet wrenches; and a special wrench for Ford reverse-gear and brake-band adjustments.

Cutting-off Machine: Hurlburt, Rogers Machinery Co., Nashua, N. H. A machine capable of cutting off stock up to 10 inches in diameter. The machine is driven by a 7 1/2-horsepower multi-speed motor. A Foster-Barker wrenchless chuck holds all sizes of stock up to 8 inches in diameter, and a special Skinner chuck is provided for sizes between 8 and 10 inches. The steadying chuck at the rear end of the spindle accommodates all sizes of stock within the capacity of the machine. There is the usual table tool-slide operated by a right- and left-hand screw. The machine weighs about 7500 pounds, including the motor.

Crankshaft Lapping Machine: Manufactured by A. P. Schraner & Co. and marketed by Kenneth Ingersoll, Book Bldg., Detroit, Mich. A machine intended for simultaneously lapping all bearings of automotive crankshafts. It is equipped with a work-holding table that oscillates back and forth during an operation. The heads for lapping the line bearings are held in a fixed position with relation to a lower cross-rod, and the heads for lapping the crankpin bearings are only guided against sidewise motion in relation to this rod. The latter heads are guided between arms which are held in a fixed position on the rod. The upper part of the heads carries a vertical shaft which passes through a fitting on an upper cross-shaft. All the fittings are held against sidewise motion, but are free to turn on the cross-shaft.

* * *

THE BRITISH METAL-WORKING INDUSTRIES

From MACHINERY'S Special Correspondent

London, September 14

The industrial situation in Great Britain continues to be completely dominated by the coal situation, which, however, may be nearer a solution than is generally realized. Several of the miners' leaders are now definitely in favor of a national settlement, and although the Mining Association—the representative body of owners—is seeking district settlements, the efforts of the government coal committee and certain responsible politicians of the labor faction seem likely to meet with early success.

Certainly the market is reflecting some optimism, and there is sure to be a demand for all classes of iron and steel as soon as the coal mines resume their normal working, for both warehouses and consumers' stocks will need replenishing. There is a confident belief that with the autumn fast approaching, a speedy and satisfactory settlement would enable works to settle down quickly and insure full steam ahead for a considerable period.

A feature of the industrial situation is the tenacity of purpose displayed by manufacturers, and the state of activity in some directions is such that one would hardly credit that the dispute has lasted for more than four months. There appears to be no serious shortage of fuel, and the position is rapidly improving, for there are now about 62,000 miners at work and the men are returning at the rate of 1500 a day. Admittedly it has been found necessary in several cases to reduce the number of days worked per week, but this applies mainly to works such as forge shops, stamping shops, and others concerned with the working of metals by hot processes. There are cases where difficulty has been experienced through a shortage of castings, bar, or sheet materials but apart from these, conditions are practically normal.

There is Good Demand in the Machine Tool Industry

Among machine tool makers in the Midlands conditions are generally regarded as satisfactory. The demand at present is firm, and most works are engaged at full capacity. A fair volume of inquiries is being experienced, which augurs well for the future. A good proportion of the requests for information emanate from industries that have not been in the machine tool market for many years and in which new equipment is badly needed.

A noticeable feature is the demand for machines for producing by methods not hitherto generally adopted in this country. At the present time considerable interest is being displayed in the hot heading process. During the last few months one specialist in heading and upsetting has sold machines to the value of over £350,000. The automobile industry appears particularly interested in the heading process, and arrangements are being made for the production of such parts as crankshafts, front axles, swivel axles and pins, gear blanks, and so on by upsetting methods or by a combination of upsetting and drop-forging.

In Scotland, the machine tool industry, like the other basic industries, is badly off for work due mainly to the prolongation of the coal dispute. The volume of work in the shipyards is good.

Activity is Evidenced in the Automobile Industry

In the automobile industry, there is considerable activity. A certain amount of inconvenience is experienced through the shortage of materials, but despite this, production continues at a fairly high level. This is the case not only with those firms that make the more popular priced light cars, but also with those works that manufacture the higher priced cars.

With the approach of the automobile show there is great activity in regard to new models. There appears to be a tendency to develop cars with six-cylinder engines of about 14 to 18 horsepower, which will be sold at prices ranging between £350 and £450.

Upward Trend of Overseas Trade in Machine Tools Continues

The upward trend of exports that the machine tool industry of Great Britain experienced in June became even more pronounced in July. There was also a distinct, though not very substantial check to imports, with a slight rise of ton-values in both cases. The values of tools and cutters exported in May, June, and July were, respectively, £45,004, £48,551 and £72,761—figures that show an exceptionally strong advance. The figures for exports and imports of machine tools in May, June, and July were as follows:

	May	June	July
Exports, tons	917	1090	1434
Imports, tons	473	622	492
Exports, value	£97,735	£110,790	£151,674
Imports, value	£57,386	£76,604	£61,404
Exports, ton-value	£107	£102	£106
Imports, ton-value	£121	£123	£125

We are now just a little ahead of last year in tonnage of machine exports, at a rise of 1 per cent in ton-value. The import tonnage continues at more than double the pre-war standard, and this extra 100 per cent must be at a very low price, because the sale of high priced foreign machines of a special kind continues at about the same level, and yet the average ton-value is depressed. In pre-war years the ratios of exports to imports were, respectively, 100 to 22 in tonnage, and 100 to 160 in ton-value; now the figures are 100 to 48 and 100 to 110.

* * *

INDEX TO MACHINERY

The index to the thirty-second volume of MACHINERY (September, 1925, to August, 1926, inclusive) is now ready for distribution. Copies will be sent to subscribers upon request.

THE LEIPZIG AUTUMN FAIR

The trade fair in Leipzig, Germany, held August 29 to September 4, gave an indication of the industrial activity that exists in Europe in spite of financial difficulties. In all fields of industry, more than 10,000 exhibitors from twenty-two countries were in evidence. Of these, 2500 were exhibitors of machinery, and 1580 of metal manufactures of various kinds. Between 150,000 and 200,000 people from forty different countries visited the fair, and those registered from the United States mounted into the thousands. A number of manufacturers from the United States had exhibitions, especially builders of automobiles, of whom about twenty were represented.

The different divisions of the fair occupy about 100 exposition buildings, covering 4,000,000 square feet of floor space, of which the machinery and electrical equipment buildings are among the most imposing. An interior view of the machine tool exhibition building is shown in the accompanying illustration. A movement is on foot to provide a special building for the display of the products of the United States in coming exhibits.

The Leipzig Fairs date far back in history, having been held annually, with but few interruptions, for 700 years. Detailed information may be obtained by those interested from the Leipzig Trade Fair, Inc., 630 Fifth Ave., New York.

* * *

NEW AUTOMOTIVE STANDARDS HANDBOOK

Thirty-four specification standards, revisions and recommended practices that were approved at the semi-annual meeting of the Society of Automotive Engineers last June and subsequently submitted to the membership for approval by letter ballot, are included with nearly 600 other approved automotive standards in the second semi-annual issue of the S.A.E. Handbook. The thirty-four specification recommendations were approved with the smallest number of negative votes received in recent years, no one specification receiving more than four negative votes, or 1 1/4 per cent.

New features of this edition are the inclusion of a list of the personnel of all the divisions of the standards committee of the society, a list of all S.A.E. specifications revised since the previous issue, and the printing of the section containing the general index and announcements of products conforming to S.A.E. standards on coated india tinted paper.

Interior of Machine Tool Exhibition Building at the Leipzig Fair

INDUSTRIAL EXPORTS INCREASE

In reporting on the exports of manufactured goods from the United States during the fiscal year ending June 30, Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce, points to the rapid growth of the American exports of manufactured goods and the great importance of foreign sales of this class of exports as a stabilizer of the total foreign trade. There are less fluctuations in the exports of manufactured goods than in the exports of raw materials.

Exports of finished manufactured goods increased 16 per cent, as compared with the preceding fiscal year, and these exports were 60 per cent greater than four years ago. They were nearly three times as great in value as the average for each year during the five years preceding the war. Even after allowing for higher prices, the volume of the exports was more than double the pre-war average. "This tremendous growth reflects," says Dr. Klein, "the ever rising efficiency in American industry, and the energy and intelligence of American salesmanship in foreign markets. * * * There is every reason to anticipate a steady increase in American exports of manufactured products. They are bound to become gradually a larger and larger share of our total exports. This is the natural result of the growing population and increasing industrial development of the country. * * *

"Exports of many important classes of manufactures were from two to nine times as great last year as in 1921-1922. The increase in exports of agricultural machinery was no less than 343 per cent, and the item of tractors gained more than 800 per cent. Exports of automobiles, parts, and accessories were more than four times as great last year as four years before, and the increase in motor trucks alone was more than 600 per cent. Exports of cash registers, adding and calculating machines, and related instruments nearly quadrupled, and those of construction and conveying machinery trebled. American leadership in quality and price of production of all classes of machinery, vehicles, and labor-saving devices is strikingly illustrated by these figures.

"Remarkable too has been the increase in exports of manufactures of iron and steel, such as cutlery, tools, and hardware, and in such supposedly European specialties as chemical products, toys, and musical instruments."

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Safe assurance of accurate gears at a low cost

The automotive manufacturer who demands a steady high production on gears will readily appreciate the cost-cutting advantages of hobbing with Brown & Sharpe Machines. Both the No. 34 for Spur Gears and the No. 44 for Spur and Spiral Gears are rugged, accurate, and easily operated.

Install one of these machines in your shop. Use it for "hogging" out gears in gangs or cutting them singly. You will find Brown & Sharpe Gear Hobbing Machines the safest insurance of better gears at a profit.

"Gear Hobbing Machines" is a booklet describing both sizes. Send for a copy.

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for Automotive Production

Products
Milling Machines
Gear Cutting and Hobbing Machines
Cutters and Hobs

BROWN & SHARPE MFG. CO.
Providence, R. I.
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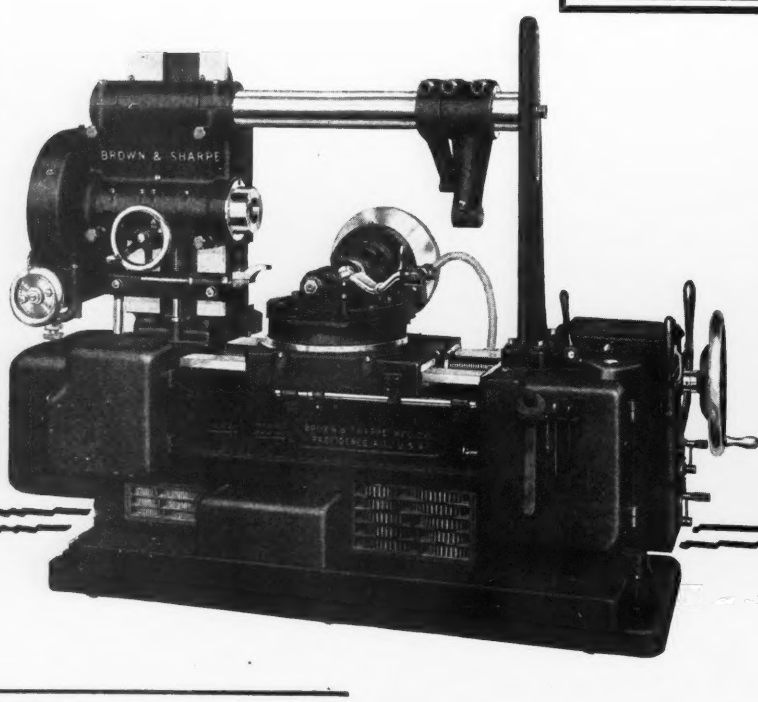
Meet keener competition the modern way

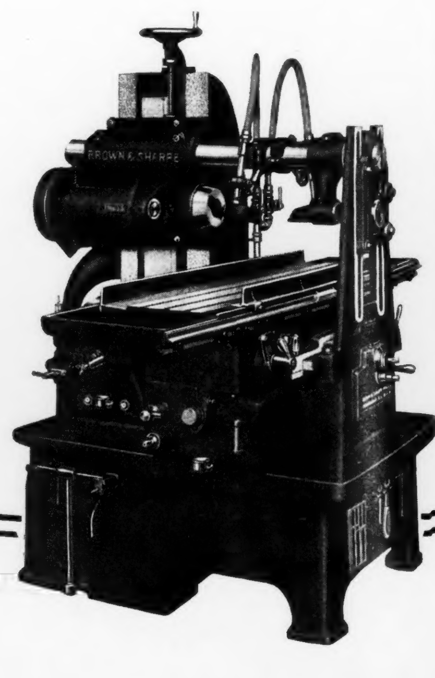
Milling *automatically* with Brown & Sharpe Machines is the modern way to reduce automotive manufacturing costs and meet increasingly keen competition.

Automatic spindle and tab'e control, including automatic spindle reverse when desired, cutting at one end of the table while loading at the other,—in these features alone there is assurance of greater profit when you put Brown & Sharpe Automatic Milling Machines on the job.

Send for the booklet "Automatic Milling Machines."

BROWN & SHARPE AUTOMATIC MILLING MACHINES
for Automotive Production





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The Brown & Sharpe "High Speed" Automatics were added to a line already famous for high production records. They are designed to handle chiefly the free cutting metals, such as brass and aluminum, and small parts of iron and steel.

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Grinding Machines
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Small Tools

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The Brown & Sharpe Nos. 10 and 11 Plain Grinding Machines are particularly suited for the rapid production of interchangeable automotive parts. Several modern features insure simplicity of set-up and operation.

After every attention is given to the excellence of other features in the manufacture of these machines, added emphasis is placed upon accuracy.

Brown & Sharpe Plain Grinding Machines are ordered and re-ordered by automotive manufacturers because they are safe insurance against costly spoilage due to the inaccuracy of the machines. Our representative will be glad to go over your requirements with you.

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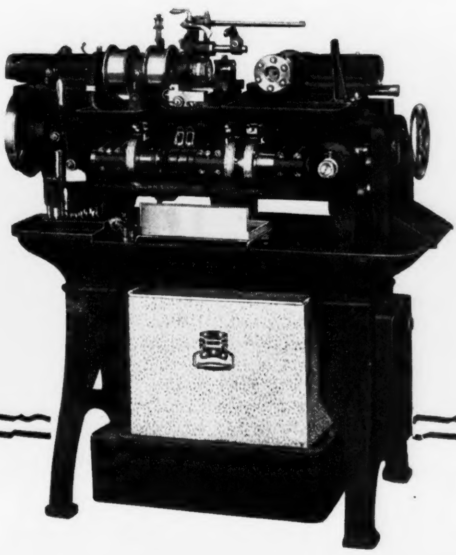

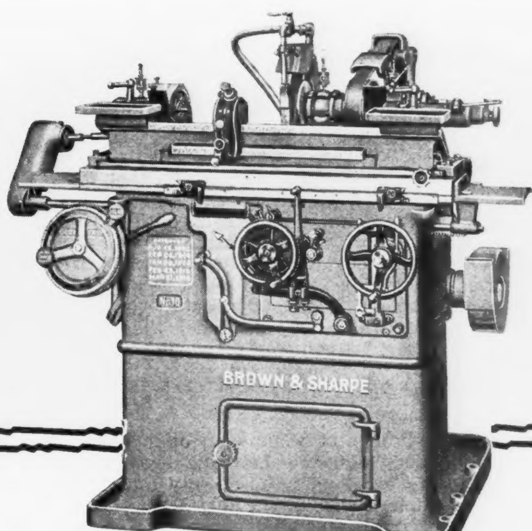

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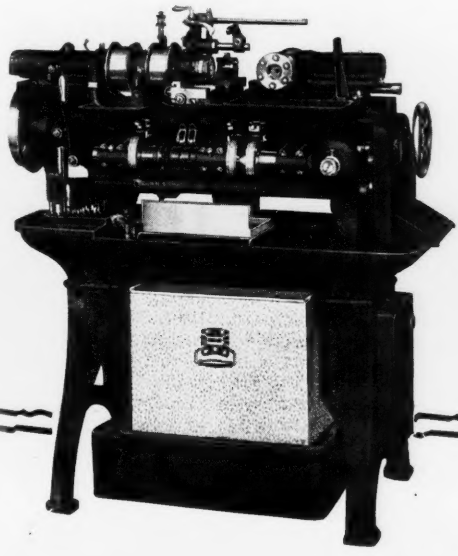

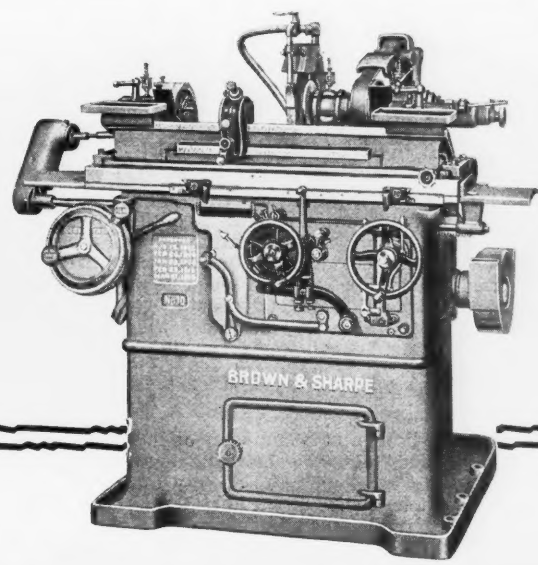

PERSONALS

W. S. JONES has been elected vice-president of the Carpenter Steel Co., Reading, Pa., in charge of tool steel sales.

J. R. TROTT has been appointed sales manager of the Abbott Ball Co., Hartford, Conn. Mr. Trott was formerly in the publicity department of the William L. Gilbert Clock Co., Winsted, Conn.

G. E. STOLTZ has been appointed manager of industrial engineering of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. C. W. DRAKE has been appointed engineer of general industrial engineering.

C. H. JOHNSON has been appointed engineer with the service department of the Timken Roller Bearing Co., Canton, Ohio. He will have direct charge of the installation of Timken bearings in automotive and industrial applications.

MAJOR F. B. WILLIAMS, formerly assistant superintendent of the Walker & Pratt Mfg. Co., Watertown, Mass., has joined the staff of the Curtis Publishing Co., Philadelphia, Pa. E. A. Stevens will succeed Mr. Williams as assistant superintendent.

J. N. JOYCE has joined the Cleveland office of the Bridgeport Brass Co., located at 2017 Superior Viaduct. Mr. Joyce will be engaged in selling Bridgeport-Keating flush valves and "Plumrite" brass pipe. He was previously connected with the Johns-Manville Co.

J. E. MACARTHUR has been appointed general manager of the Abbott Ball Co., Hartford, Conn. Mr. MacArthur was formerly works manager of the Russell Motor Car Co., and was previously connected with the Brown & Sharpe Mfg. Co. and the Pierce Arrow Motor Car Co.

CARL G. SCHLUEDERBERG has been appointed general manager of the George Cutter Co., South Bend, Ind., a subsidiary of the Westinghouse Electric & Mfg. Co. Mr. Schluederberg will be in charge of all the operations of that company, including sales, engineering, and manufacturing.

MERRILL C. MORROW, formerly assistant to the general manager of the merchandising department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been appointed assistant sales manager of the same department. His headquarters will be at the Mansfield plant of the company, Mansfield, Ohio.

DEANE S. HAZEN, formerly a management consultant at Springfield, Mass., and for eight years associated with the National Acme Co., Cleveland, Ohio, first as assistant advertising manager and later in charge of plant reorganization, has been appointed assistant sales manager of W. L. Brubaker & Bros. Co., 50 Church St., New York City.

T. B. BUELL, formerly of the New Process Gear Corporation, Syracuse, N. Y., has joined the sales force of the Sundstrand Machine Tool Co., Rockford, Ill., and will act as sales engineer in the eastern territory, with headquarters at Syracuse. L. A. DUMSER, formerly with the Kearney & Trecker Corporation, Milwaukee, Wis., will serve in the same capacity in the middle west territory, with headquarters in Milwaukee.

RALPH L. SHAW has been appointed Milwaukee district representative of the W. A. Jones Foundry & Machine Co., Chicago, Ill., succeeding FRED E. HOLTZ. Mr. Shaw will make his headquarters at the present sales office of the company—425 E. Water St., Milwaukee, Wis. He has been actively connected with the home office and factory for twelve years, and for several years has been the Chicago district sales manager.

FARRAND HALL, who for several years has been district sales manager of the Cleveland territory for the Carborundum Co., has been transferred to the sales department at the main plant in Niagara Falls, N. Y. The position of district sales manager in Cleveland will be filled by HARRY COLLINSON, who will be transferred from Milwaukee. CARL J. STEUBER will succeed Mr. Collinson at the Milwaukee district sales office. Mr. Steuber was formerly a special service representative in the coated abrasive division of the company.

ARTHUR JACKSON, 52 Glenholme Ave., Toronto 10, Ontario, Canada, who is a direct factory representative for a number of United States machine tool manufacturers, specializing particularly in mass production machine tools, has opened a Montreal office at Apartment 8, 437 Grosvenor Ave., Westmount, Montreal, Canada, which will be under the management of Victor Larson. Mr. Larson was formerly production manager of the Canadian Ingersoll-Rand Co., and for the last few years has been managing director of the Sleeper & Akhurst Co., Ltd., Coaticook, Quebec.

OTTO M. BURKHARDT, who has been manager of the research department of the Society of Automotive Engineers since March 1925, has left the employ of the society and is now associated with the Buick Motor Co., Flint, Mich. During the time that Mr. Burkhardt was manager of the research department of the S. A. E. a great deal of valuable research work was carried on relating to motor vehicle brakes, crankcase oil contamination, head lamp illumination, tires, shock absorbers, springs, and on the subject of riding qualities of motor vehicles, as well as on the durability, quietness and efficiency of gears.

* * *

RAILWAY TOOL FOREMEN'S CONVENTION

The fourteenth annual convention of the American Railway Tool Foremen's Association was held at the Hotel Sherman, Chicago, Ill., September 1 to 3. The convention was attended by 113 members, representing fifty-three different railroads. In connection with the convention a tool exhibit was held, at which seventy-six firms exhibited. O. D. Kinsey of the Chicago, Milwaukee & St. Paul Railroad was elected president for the coming year. G. G. Macina of the same railroad remains secretary-treasurer.

During the meeting reports were presented on many subjects relating to the railway tool foreman's work. Among these may be mentioned reports on new labor-saving tools and devices for the air brake department, the training of men suitable for tool-room work, standardization of special boiler taps, general locomotive shop kinks and devices, and new tools and safety devices for the car department.

In the report relating to the training of men suitable for tool-room work, the value of showing apprentices work that does not come up to the standard, as well as acceptable work, thus enabling the boy to make a comparison, was pointed out. In training boys for tool-room work they should be started with the idea that quality comes before quantity. Eventually they will acquire speed from practice. At the same time, they should be given some idea of the money value of the piece work on which they are engaged.

It was recommended that an apprentice for tool-room work in a railroad shop should spend the first six months in the tool-room, the next six months in the general machine shop, another six months in the erecting shop, then six months in the heat-treating department, and the remainder of his time in the tool-room. A simple system of grading or marking, whereby the apprentice is kept informed as to his progress in comparison with other apprentices on similar jobs, was recommended. The desirability of a library, where both apprentices and other tool-room employes would find books and technical periodicals of value to them, was pointed out.

Specifications for a number of different types of taps for boiler work were adopted.

* * *

PRODUCTION COMMITTEE OF THE S. A. E.

As a result of conferences held in Cleveland and Detroit by members of the Society of Automotive Engineers who are directly interested in production work, it has been decided to organize a production committee. The cooperation of production men in the industry will be enlisted for the further development of the society's production activities.

The efforts of the committee will be devoted principally to developing activities of interest to production members with relation to standardization, research, presentation of papers, and the holding of meetings, both sectional and national. Part of the plan of organization is to have production committees in the local sections, particularly in Detroit, Cleveland, Milwaukee, and Chicago, to develop and carry through programs of interest in their vicinity. The production division of the standards committee that was instituted this year will take an active interest in the further development of production activities, as it is felt that much of the new committee's work will deal with standardization.

* * *

WORLD'S AUTOMOBILE STATISTICS

The Automotive Division of the Bureau of Foreign and Domestic Commerce has compiled some interesting statistics covering the automobiles in use throughout the world. According to these figures, there are nearly 20,000,000 cars and trucks in use in the United States, and approximately 4,600,000 in other parts of the world. The United Kingdom has 816,000 cars; France, 735,000; Canada, 716,000; Germany, 323,000; Australia, 291,000; Argentina, 179,000; and Italy, 115,000. Next in order come New Zealand, Belgium, Sweden, and Spain.

It is also of interest to note that in the United States there is a car for every 6 inhabitants; in Canada, one for every 13; in New Zealand, one for every 14; and in Australia, one for every 20. In the United Kingdom there is one for every 55 inhabitants; in France, one for every 53; and in Germany, one for every 193. Of the European countries, Denmark has more automobiles, in proportion to population, than any other country, there being one car for every 50 inhabitants.

TRADE NOTES

BILODEAU BALL BEARING WORKS, INC., has removed its office and factory to 92 Brookline Ave., Boston, Mass.

SOCIETE ANONYME ALFRED HERBERT has moved from 47 Boulevard de Magenta, Paris, France, to 1-3 Rue du Delta, Paris.

MARSHALL & HUSCHART MACHINERY CO. is now located in new quarters at 571 W. Washington Blvd., at Jefferson St., Chicago, Ill.

BURKE ELECTRIC CO., Erie, Pa., manufacturer of motors, generators, and welding equipment, has appointed E. I. Van Doren, 206 Times Building, Troy, N. Y., district sales agent.

COGSDILL MFG. CO., Detroit, Mich., is building an addition of 35 by 140 feet to its present factory to take care of its increasing volume of business in "Cogsdrills" and other metal-cutting tools.

CHROBALTIC TOOL CO., 1501 Ferry Ave., E., Detroit, Mich., has recently completed a new foundry at Michigan City, Ind., especially designed for the manufacture of heat-resisting and special alloy castings.

KIRK & BLUM MFG. CO., Cincinnati, Ohio, designing engineer and manufacturer of pneumatic dust-collecting, ventilating, and conveying systems, has doubled its plant facilities through the purchase of an adjoining factory.

C. L. GOUGHLER MACHINE CO., builder of special machinery, has moved from 219 River St., Kent, Ohio, to larger quarters on Stow St. The new location affords the company a working floor space of 50 by 200 feet.

JOSEPH HYMAN & SONS, dealers in new and rebuilt power presses, have recently moved into their own building at Tioga, Almond and Livingston Sts., Philadelphia, Pa., where they will carry in stock presses of various makes and sizes, ranging from 6000 to 250,000 pounds.

RELIANCE ELECTRIC & ENGINEERING CO., 1056 Ivanhoe Road, Cleveland, Ohio, has placed a contract for an addition to its main plant with the Austin Co., Cleveland, Ohio, engineers and builders. The new unit will be 40 by 80 feet, two stories high, and will greatly increase the production of the winding department.

CENTRAL ALLOY STEEL CORPORATION, Massillon, Ohio, is the name of the corporation formed by a merger of the CENTRAL STEEL CO., Massillon, Ohio, and the UNITED ALLOY STEEL CORPORATION, Canton, Ohio. F. J. Griffiths is chairman of the board; C. E. Stuart, president and treasurer; and B. F. Fairless, vice-president and general manager.

RUSTOMJI NOWROJI BAPASOLA, Mubarak Manzil, Apollo St., Fort, Bombay, India, announces that the firm is in a position to represent manufacturers in the Indian market in electrical accessories, tools, and mineral oils. Only exclusive agency arrangements are desired. The firm, which was established in 1909, is prepared to give satisfactory references.

FEDERAL PRESS CO., Elkhart, Ind., announces that the company is now supplying its line of open-back inclinable power presses fitted with individual electric motor drive. The motor supporting bracket is adjustable, so that the motor remains level even when the press is inclined. The drive is through a leather belt, the length of which does not have to be changed whether the press is operated in an upright position or inclined to any angle up to a maximum of 40 degrees.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburg, Pa., has created a new department known as the circuit-breaker engineering department, which will be under the direct management of J. B. MacNeill, who has been in the employ of the company since 1913. The company also announces the opening of a branch office at Columbus, Ohio, with J. K. B. Hare as manager. Mr. Hare has been in the employ of the company since 1912, and was formerly in charge of syndicate public utility sales for the Pittsburg district.

HERBERTS MACHINERY & SUPPLY CO., Third and San Pedro Sts., Los Angeles, Cal., was awarded the Blue Ribbon for the best mechanical and electrical exhibit at the recent industrial and trade exposition held in Los Angeles. The company occupied eight booths and had running under power approximately twenty-five machine tools, including drilling machines, milling machines, turret lathes, bolt-threading machines, shapers, hacksaws, presses, etc. The Blue Banner, which was the grand award for the best exhibit in the auditorium, was also presented to this company.

CLEVELAND PLANER CO., 3148 Superior Ave., Cleveland, Ohio, announces that the Seifreat-Elstad Machinery Co., Dayton, Ohio, is now acting as exclusive representative for the sale of Cleveland open-side planers in southern Ohio, eastern Indiana, and the state of Kentucky east of the Tennessee river. The Brownell Machinery Co., of Providence, R. I., has been appointed exclusive agent in the state of Rhode Island, county of Bristol in Massachusetts, and counties of New London and Windham in the state of Connecticut.

AMERICAN DIE & TOOL CO., Reading, Pa., announces that the company has engaged in the quantity production of machine tool chucks. By adopting the policy of manufacturing only in fairly large quantities, the company has made it possible to make use of its production and automatic machine tool equipment, with consequent interchangeability of parts and low cost. Three-jaw universal scroll chucks are now being made, and additional types, including steel-body and independent-jaw models, will be produced as soon as a fair volume of demand develops.

CINCINNATI GRINDERS, INC., Oakley, Cincinnati, Ohio, has been incorporated with an authorized capital of $1,500,000 common stock, to take over the grinding machine business of the CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio, and the centerless grinder business of the HEIM GRINDER CO., Danbury, Conn. The new company has acquired the plant of the Triumph Electric Co., Oakley, Cincinnati, and will immediately convert this property into a modern and well-equipped grinding machine plant. It is expected that the new plant will be in operation early in 1927, when several hundred men will be employed. Men identified both with the Cincinnati Milling Machine Co. and the Heim Grinder Co. will act as executives and directors of the new company. P. O. Geier is president; George W. Binns, secretary; and F. M. Angevin, treasurer. R. E. W. Harrison, C. Booth, W. Peaslee, and P. H. Cone are the other directors of the company. The manufacture of the Heim centerless grinders and the Cincinnati plain, universal, and centerless grinders will be continued as heretofore by the new company.

COMING EVENTS

OCTOBER 12-13—Autumn convention of the American Management Association at the Hotel Statler, Cleveland, Ohio. W. J. Donald, managing director, 20 Vesey St., New York.

OCTOBER 14-16—Semi-annual meeting of the American Gear Manufacturers' Association to be held at Briarcliff Lodge, Briarcliff Manor, N. Y. T. W. Owen, secretary, 2443 Prospect St., Cleveland, Ohio.

OCTOBER 22—Meeting of the American Iron and Steel Institute at Hotel Commodore, New York City. Secretary's address: 40 Rector St., New York City.

NOVEMBER 12-20—New Haven Progress Exposition to be held under the auspices of the New Haven Chamber of Commerce at Exposition Hall, Winchester Ave., corner of Munson St., New Haven, Conn.

NOVEMBER 16-18—Transportation and service meeting of the Society of Automotive Engineers at the Copley-Plaza Hotel, Boston, Mass. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

NOVEMBER 16-19—Eighth annual fall meeting of the American Welding Society in conjunction with the International Welding and Cutting Exposition, Inc., at the Broadway Auditorium, Buffalo, N. Y.

DECEMBER 6-9—Annual meeting of the American Society of Mechanical Engineers at the Engineering Societies Building, 29 W. 39th St., New York City. Calvin W. Rice, secretary.

DECEMBER 6-11—Fifth national exposition of power and mechanical engineering at the Grand Central Palace, New York City. Managers of the exposition: Charles F. Roth and Fred W. Payne of the International Exposition Co., Grand Central Palace, New York City.

SOCIETIES, SCHOOLS AND COLLEGES

UNIVERSITY OF THE CITY OF TOLEDO, Toledo, Ohio. Catalogue for 1925-1926, containing outline of courses and announcements for 1926-1927.

NORTH DAKOTA STATE SCHOOL OF SCIENCE, Wahpeton, N. D. General information bulletin (1926-1927) of the Junior College and State School of Trades and Industries.

NEW BOOKS AND PAMPHLETS

PHYSICAL EXAMINATIONS IN INDUSTRY. 40 pages, 5¼ by 7¾ inches. Published by the Metropolitan Life Insurance Co., 1 Madison Ave., New York City, as Industrial Health Series No. 2.

LETTERING EXERCISE MANUAL. By Jonathan Bright and John F. Faber. 32 pages, 8 by 5 inches. Published by the Bruce Publishing Co., 354 Milwaukee St., Milwaukee, Wis. Price, 28 cents.

This little pamphlet is a manual intended to teach the student how to make inclined Gothic lettering, which is a style commonly used on mechanical drawings. The exercises are planned to teach the spacing of letters and words by having the student letter directly under the sample copy.

DIESEL ENGINES—MARINE, LOCOMOTIVE, AND STATIONARY. By David L. Jones. 565 pages, 6 by 9 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $5.

This book was written and compiled with the object of presenting to the practical operating engineer the elementary principles, care and